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8 MARCH
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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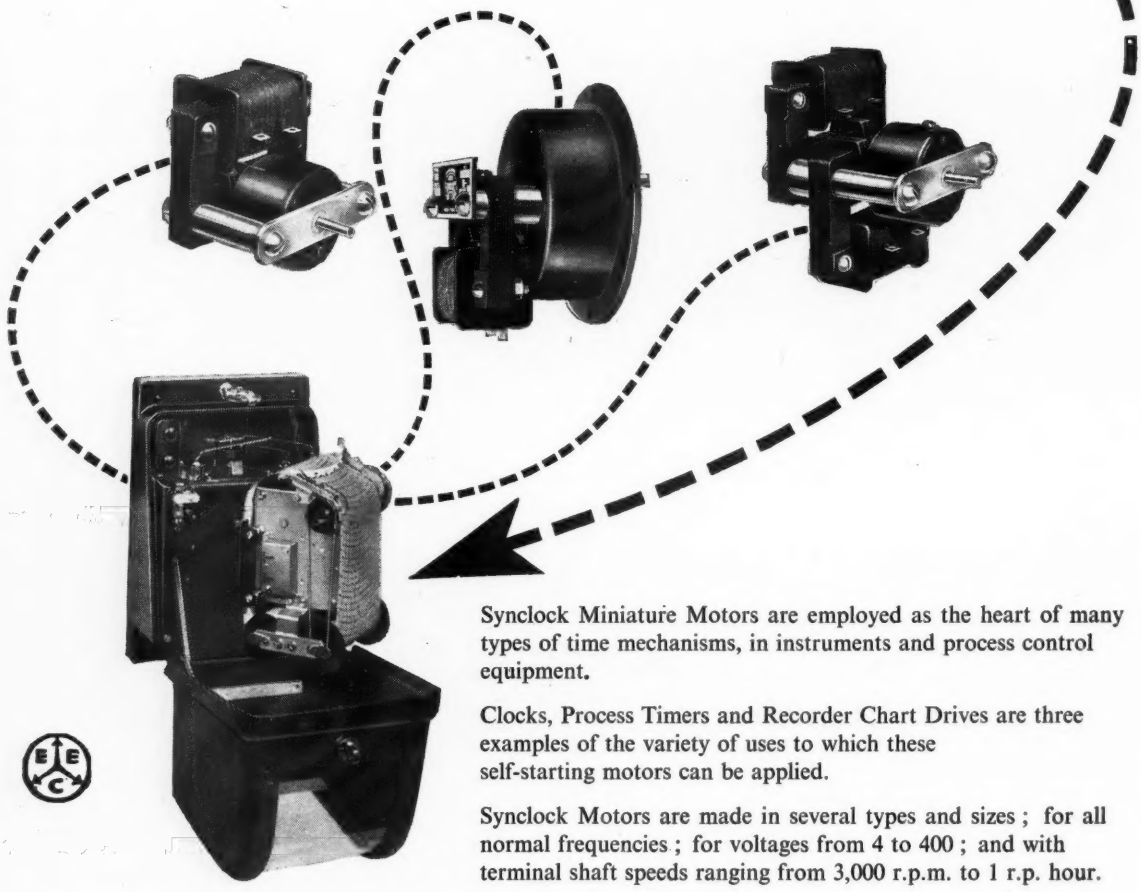

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ELECTRICAL REVIEW

8 March 1957 Vol. 160 No. 10 Established 1872

Nuclear Reactor Operation

THERE are not many people in this country at the present time who have had any experience in the operation of a nuclear power station, but in view of the impending construction of base load nuclear generating plants, there is a widespread interest in the subject. For this reason we are publishing in this issue an article by Mr. K. L. Stretch, which reviews and explains the majority of the problems involved, with particular reference to the Calder Hall installation.

Much of the plant in a nuclear power station is the same as that found in a conventional plant. Thus the operational factors are well known and control equipment has reached an advanced stage of development. The reactor and its associated heat exchangers, however, pose control and operational problems more difficult to solve than those associated with the " fossil " fuel fired boilers which they are superseding. Initial practice indicates that the nuclear power station will incorporate a separate control room for each reactor and its associated group of heat exchangers. It may be possible, however, that at some time in the future we shall see nuclear power stations operating on the unit principle as in the latest types of conventional stations.

The Calder Hall arrangement, where there are separate reactor control rooms, appears to have worked very well for the past nine months and much of what has been learned is described by Mr. Stretch. He shows that it is most important that the reactor shall be trimmed to obtained the correct neutron flux distribution throughout the core or moderator block before the reactor goes fully active. At the same time the charging of the reactor must be carried out with extreme care to ensure that in no circumstances can the reactor start diverging inadvertently.

A disadvantage with the Calder Hall reactor is that it must be shut down for charging and discharging and for removing burst fuel elements. The nuclear plants being constructed for the Central Electricity Authority and the South of Scotland Electricity Board are capable of having their reactors charged and discharged while on load so there will be no interruption in the generated output. It must not be thought, however, that frequent fuel element changes are likely to be necessary because at Calder Hall, where there are something like 10,000 of them in the reactor, only two have failed during the past nine months. This is an extremely good record and it should also be borne in mind that a reactor can be shut down or started up and put on load far more quickly than a conventional fuel fired boiler of the same heat rating. Thus, contrary to common belief among generating engineers, the nuclear reactor need not be confined to base load operation.

It appears that, so far, the problems involved in reactor control and operation have been overcome successfully but as plants increase in size and complexity other difficulties will present themselves. For instance, the reactors being built for the Central Electricity Authority will be physically about twice the size of those at Calder Hall and have something of the order of four times the output. The numbers of fuel elements, coolant gas pressures and temperatures, steam conditions and power outputs are all

rising very steeply in what is still an early stage in the development of nuclear power plant.

It seems to us that in view of the outstanding achievements of British engineers in this particular sphere of activity no insuperable difficulties are likely to arise in the design of equipment. Serious thought, however, must be given to the manning of the stations and training schemes for nuclear power plant operators should be organised at the earliest possible opportunity.

ENGINEER-ADMINISTRATORS

Support for our oft-repeated contention that engineers can be as suitable material for administrators as any others came from Dr. Charles Hill, Chancellor of the Duchy of Lancaster, at last week's annual dinner of the Institution of Electrical Engineers. Responding to the toast of the guests Dr. Hill pointed to the President, Sir Gordon Radley, who is now Director General of the Post Office, as an example of the engineer turned administrator. From his association with the President while Postmaster General he expressed his high appreciation of Sir Gordon's ability and human qualities.

Dr. Hill said that Sir Gordon was an outstanding proof that engineers were just as likely to be first-rate administrators as those who came from what are considered to be the administrative classes.

COMMONWEALTH STANDARDS

We conclude in this issue (page 433) our report of the recent Commonwealth Standards Conference held in New Delhi. It will be seen that in most cases British Standards were adopted as a basis for the discussions but useful suggestions were made for bringing them into line with the needs of Commonwealth countries in which climatic and other conditions are often very different from those in this country.

Much attention was devoted to cable make-up and testing, one aim being to secure economies without incurring risks. Differences of outlook were apparent in the discussions on the construction of domestic electrical appliances from the safety aspect. The main difference was found between practice in the United Kingdom and in Australia, where standards have legal status.

One matter which was raised from time to time was the necessity of aligning, where possible, Commonwealth standards with those of other countries. The point arose particularly in the consideration of the electrical equipment of machine tools.

PROPOSED CHANGE OF TITLE

We report on page 444 of this issue proposals for alterations in the memorandum and articles of association and the by-laws of the Illuminating Engineering Society which include a change of name. The principal reason given for the change is the extension of the scope of the membership since the Society was established nearly fifty years ago. In the early days the engineering aspect dominated its activities; the Council says that "the practice of lighting now involves the study and consideration of many other arts and sciences." A common body to co-ordinate the various interests concerned with lighting seems to be a necessity and although the engineer-members may feel that they will lose something if the proposed style "The Lighting Society" is adopted, the change is certainly in line with the widened representation of the organisation.

The other main alteration suggested is that the Register of Lighting Engineers should cease to exist and that, instead, the Council should award diplomas in lighting engineering. While this would preserve the distinctiveness of the engineering element in the Society, the proposed style of "D.M.L.S." (Diploma Member of the Lighting Society) would not make the same public impact as "Registered Lighting Engineer." Possibly some way round this difficulty can be found: why not "T.M.L.S." (Technical Member of the Lighting Society)?

WHO SHOULD PAY?

Rural electrification cropped up during the consideration of the Electricity Bill by Standing Committee D of the House of Commons last week. The point was whether the finances of an individual Area Board should be imperilled by the heavy cost of rural development. Mr. Hayman, one of the speakers, pressed rather heavily the amenity value of electricity to country dwellers and particularly mentioned television. While this is most important in attracting people to the land and keeping them there it is the less remunerative aspect of electricity supply. What the Boards need is a full use of the service for work about the farm. Mr. Hayman rightly said that it was unfair to place the burden of rural consumers on those in the towns.

The Opposition's solution to the problem was a central fund, administered by the Electricity Council, from which Boards with heavy rural expenditure could be assisted. Something similar has been done on one or two occasions from the Central Electricity Authority's central fund. We have always advocated that rural electrification, if considered to be of national importance, should be helped by grants from the Exchequer. This contention received support from Mr. Fort who said that a nationalised industry should not be expected to subsidise other industries, such as agriculture.

ELECTRICITY AND AIR POLLUTION

Although about one-quarter of the coal burned in this country is used in the production of electricity, the efficiency of generation is so closely linked with smokelessness that the electrical engineer's contribution to clean air can be only a small one. It depends largely on improvements in measures to eliminate grit and dust and to render harmless sulphur-dioxide emissions from chimneys.

The first is a matter of continuing present progress. The most successful way found so far of dealing with the second is to discharge the effluent from high chimneys, as used at power stations but not so often at general industrial works—much the greatest offenders, the more general electrification of which would go a long way towards solving the problem as a whole.

Review of the Problems Involved in

NUCLEAR POWER STATION OPERATION

By K. L. STRETCH, M.A.(Cantab.), LL.B.(Lond.), A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E.*

NUCLEAR power stations are peculiar in the amount of effort which is necessary to determine the excess reactivity installed in the reactor and available for operating it. This is to ensure that enough reactivity is available for operating to full power under all conditions. Leaving more reactivity installed than is needed for this purpose is expensive and can entail awkward operational problems. It is also advantageous to get the reactor trimmed as closely to its correct form as possible at low power, as at this stage, before the reactor first goes fully active, access to the core is possible and correction of errors or repatterning is much easier than after it has been properly irradiated. In addition, charging of the reactor must be carried out with strict control of the operation to ensure that in no circumstances does the reactor start diverging inadvertently.

As our knowledge of reactors increases and grows more accurate in every detail of the design, a state may be reached when it is possible to design and charge a reactor without going through the complete routine which is adopted at present, but until then a very careful approach to critical and check of the reactor parameters is needed with each new design of reactor.

Safety of Operation

Having ensured that there is sufficient reactivity installed to enable the reactor to operate, it is equally important to ensure that the control and safety devices are of adequate capacity and suitable characteristic for controlling the reactor in all phases of its operation. Here again more information is needed before it will be possible to design control rod installations in detail with absolute accuracy. It is, therefore, necessary to carry out careful tests and calibration on the installed systems to establish their reliability under all conditions. In the Calder type of reactor it has proved possible to design the reactor and control system so that there is a very high degree of inherent safety. The reactor's own characteristics are such that, provided the release of reactivity into the pile is not at too great a rate, the increase in temperature during a rise in power tends to shut the reaction down and keep it under control. To ensure that the reactivity cannot be released at too high a rate, the control rod system has been designed with a very slow maximum rate of withdrawal, and it is therefore practically impossible on the Calder type of reactor to inject reactivity at a rate which would cause a serious accident.

Having designed a pile which is inherently safe against major incidents, the main conditions to guard against, to ensure safe and efficient operation, are an unchecked rise in power above the safe level or a loss of coolant flow in the reactor circuit when at power, either of which would cause overheating of the fuel elements. Protection against the loss of cooling is mainly provided by tripping circuits which ensure that if cooling is lost for any reason the control rods are dropped into position immediately, so that the reactor power is run down at a faster rate than the loss of cooling. There are a number of these tripping circuits, actuated by such conditions as failure of the electricity supply to the blowers or loss of coolant pressure.

Too high a rate of release of reactivity is already guarded against by the slow rate of control rod withdrawal, and when charging the rate of addition of metal through the charge system is of an even lower order. In addition, there are power level indicators connected to further tripping circuits, so that even if for some reason a power surge were to take place the control rods would be dropped into position before the level passed seriously beyond the capacity of the cooling circuits.

At Calder Hall the control rods are lowered vertically into the reactor from the control rod mechanisms mounted on the top of a number of charge holes (see Fig. 1). The control head is merely a three-phase motor operating a

* United Kingdom Atomic Energy Authority.

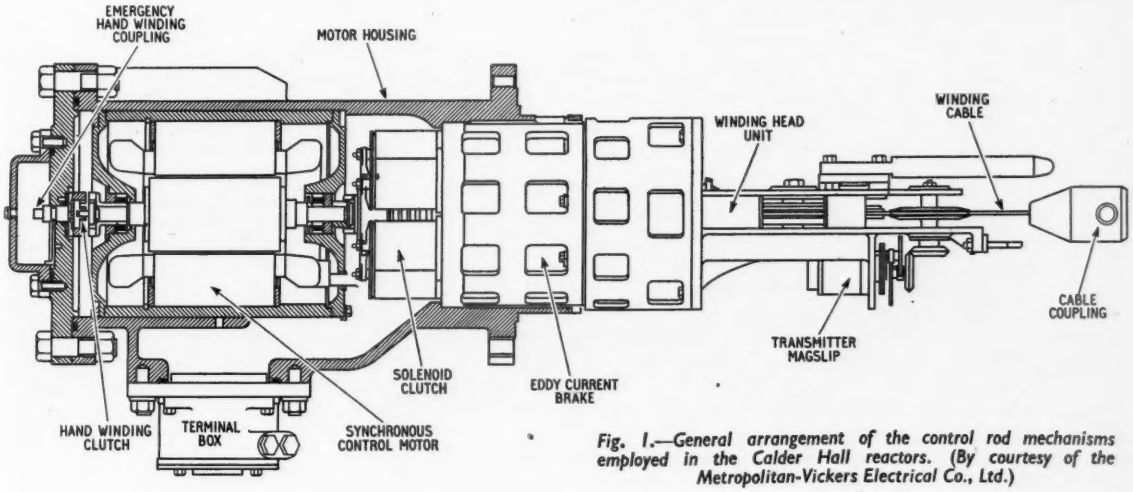


Fig. 1.—General arrangement of the control rod mechanisms employed in the Calder Hall reactors. (By courtesy of the Metropolitan-Vickers Electrical Co., Ltd.)

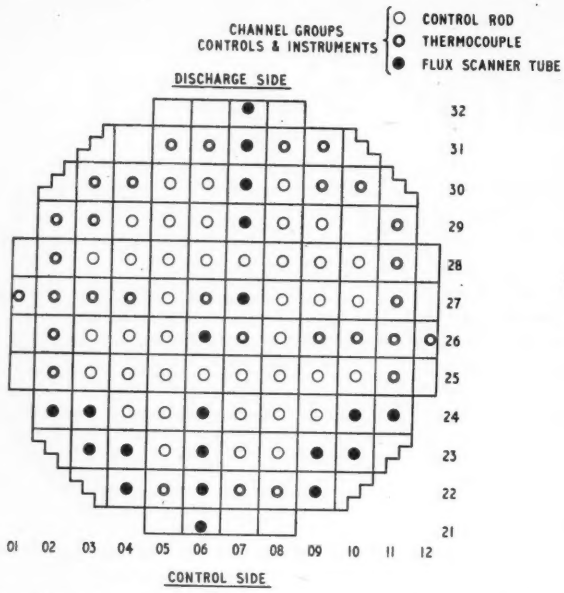
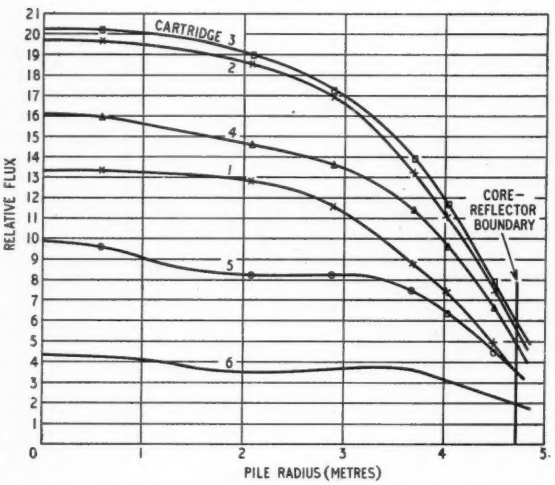

CHANNEL GROUPS
CONTROLS & INSTRUMENTS
CONTROL ROD
THERMOCOUPLE
FLUX SCANNER TUBE
DISCHARGE SIDE
CONTROL SIDE
01 02 03 04 05 06 07 08 09 10 11 12
21 22 23 24 25 26 27 28 29 30 31 32

Fig. 2.—The initial pattern of control rods adopted at Calder Hall

Fig. 3.—Radial flux distribution in planes through centre of cartridge



winch which raises and lowers the control rod to its appropriate position. The motors are held stationary or driven in either direction by a frequency convertor, the frequency of which is determined by a pilot motor and gearbox which only allow a rate of withdrawal of the rods of about 1 cm/sec, equivalent to a rate of release of reactivity of 2×10^{-6} K/sec. In the reverse direction, insertion speeds are 10 and 100 times this figure. The tripping circuits operate by taking all power off the clutch which connects the motor to the winch and allowing the rods to drop into the reactor under their own weight.

As a large number of identical mechanisms are provided, and these can be mounted on any charge tube, there is freedom to alter the number and pattern of rods in accordance with the programme of operation. With regard to capacity, the criterion that has been adopted at Calder Hall is to ensure that the total reactivity which can be absorbed by the control rods is at least equivalent to the installed reactivity of the reactor, plus any possible build up of reactivity during operation, plus one per cent to ensure that the reactor can under the worst cold, unpoisoned conditions be shut down by this amount. This amount of control rod capacity ensures that in an emergency the reactor is shut down to a very much greater degree and, in fact, power falls off rapidly when the rods have been inserted a very small distance. But the capacity is essential to ensure that even when work is being done on the reactor in the shut-down condition there is no danger of the decay of poisons and gradual cooling of the system allowing the reactor to become divergent.

As well as the inherent and built-in safety of the control rod system, the reactor is liberally provided with additional protective circuits. These are in two classes dependent mainly on the time constants of the effect against which protection is required, those with long time constants being mainly alarm circuits, and those where the time constants are short being tripping circuits. As well as the ones which have already been mentioned, which shut down the reactor if the power level rises above a predetermined figure or there is a loss of coolant, a trip condition also occurs if any of the supplies to the control system or essential instruments are lost. In general, all the essential safety circuits fail to safety, as loss of power to any of them opens the supply to the control rod clutch mechanisms and shuts down the reactor.

It will be appreciated that a system such as this can introduce some degree of unreliability, due to spurious effects on the instrument causing unnecessary trips when the reactor condition is quite safe. An attempt has been made to overcome this by using a parallel-series arrangement of trip relays, so that two similar instruments must fail or record the fault condition before tripping action takes place. In addition, it is essential to establish a very rigid maintenance and calibration routine to ensure that at all times the safety circuits are in good order, and that mal-operation during servicing does not lead to unnecessary reactor shut-downs. There is also a long-term need to establish long lives and high reliability in the types of instruments and circuits which are used for this work, as it is clearly desirable to have the maximum degree of protection without being involved in spurious shut-downs.

Before leaving the consideration of safety of operation it must be emphasised that with gas-cooled reactors of the Calder type the chance of even the most serious incident having any external effect is remote. Even in the worst conditions the damage should be contained within the reactor, and involve loss of production time and awkward problems of cleaning-up for the operations staff, but have little effect outside the plant.

Efficiency of Operation

Having established the reactor parameters and tested and calibrated the control rod system, the next problem to consider is the flux pattern and coolant distribution to enable the reactor to operate efficiently. The initial pattern of control rods that was adopted at Calder is shown in Fig. 2. It will be noticed that in this the rods had been concentrated towards the centre of the reactor. This pattern was adopted initially because at this stage there was still some margin of error in the exact control rod capacity and excess reactivity figures and it was, therefore, decided to adopt a pattern which erred on the side of increasing control rod capacity and safety, rather than on extracting the maximum power and efficiency from the plant. Operational experience has, however, indicated that this concentration towards the centre can cause considerable flux distortion, particularly at part loads.

In reactors which are designed for power production,

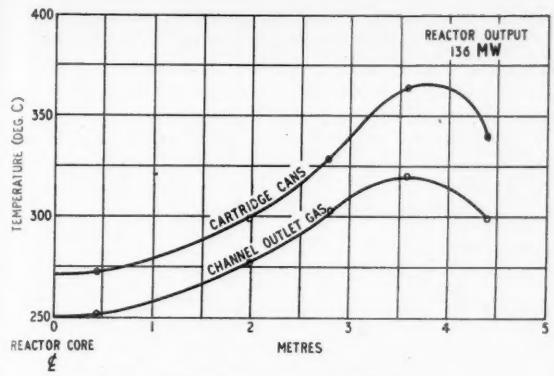


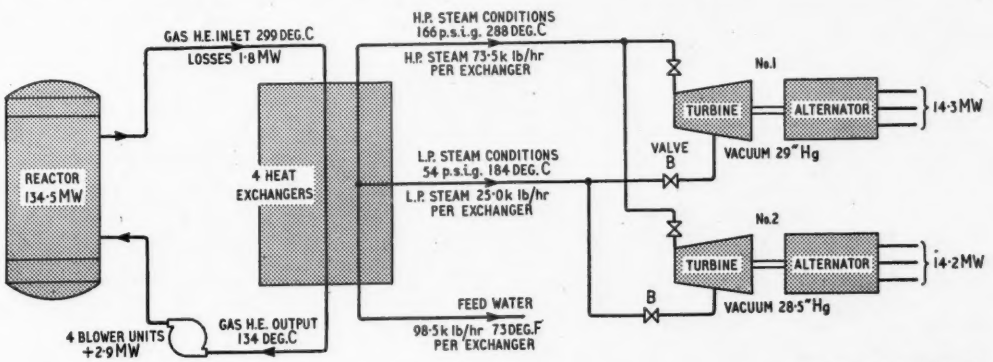
Fig. 4.—Radial reactor core temperatures

patterning the coolant flows to ensure that a reasonable efficiency is obtained is quite critical, particularly with the present temperature limitations imposed by the fuel elements. As the present canning materials set quite a low upper temperature (by normal power generation standards) for the maximum temperature in the entire reactor circuit, it is important that all temperatures throughout coolant and steam circuits shall be maintained as high as possible, to keep up the thermal efficiency of the plant. This involves quite a different approach on a power reactor, where the interest lies in the overall output of electrical power for a given commitment in capital costs and fuel burn-up, to existing plutonium producing reactors, where the main object is extraction of the maximum output of heat to obtain as much plutonium as possible. To attempt to achieve this, channels in the Calder Hall reactors are gagged so that the coolant flow up each is matched to the expected flux and power output in the channel. Ideally, a constant outlet temperature of the gas at the top should be obtained, but as the essential factor is to ensure that the fuel elements are not adversely affected, it is not possible to approach this too closely. Working to a constant maximum metal temperature means that in the central channels where the heat released is highest the temperature of the outlet gas is lower than in the outer regions where the heat released is less. It is, however, the nearest approach to an ideal distribution which the metallurgical limitations of the fuel elements will allow.

When commissioning, an extensive testing programme is carried out in air at normal pressure to check whether the pattern of gas flows provided by the gags is what had been designed. When trimming the reactivity of the pile with absorbing material it is then essential to make certain that the pattern of flux distribution across it is not distorted. If any serious distortion does occur, as it is essential that the hottest elements should not be raised to a temperature where damage can occur, it means that in the cooler regions the heat released in the gas stream is at a considerably degraded temperature. Similarly, when patterning the control rods it is most desirable that the pattern should not introduce any distortion of the flux; otherwise when running at part loads or at phases of the fuel cycle where the build-up of reactivity necessitates a considerable insertion of the rods, the thermal efficiency of the station will be markedly down.

An example of the effect obtained is shown in Figs. 3 and 4 which illustrate the flux pattern and temperature across the Calder reactor under the conditions at which it was stabilised out at the end of August, while the turbines were commissioned and the official ceremony was awaited. As the control rods had been concentrated into the centre of the reactor and some additional reactivity had been left in the reactor in case the poisoning coefficients were higher than expected, when stabilised out at a power short of full load the control rods were inserted a considerable distance into the reactor. This caused a marked reduction in flux and drop in temperature in the central channels which meant that the outlet gas temperature was low and the thermal efficiency not up to the design figure. Repatterning has, of course, now taken place to improve the performance.

Ideally, the difficulty with control rods would be resolved if the amount of absorber in the reactor could be continually adjusted so that the rods were almost entirely out of the reactor under normal running conditions. This would mean a constant adjustment of the amount of absorber, and as such adjustment could only be done when the reactor had been shut down and depressurised, a considerable loss of operating time would be demanded by such a programme. It is, therefore, more economical to run with the rods partially inserted some of the time, rather than to be continually shutting down to alter the trim of the reactor. In later nuclear reactors when facilities are provided for charging and discharging fuel or absorber under operating conditions, it should prove possible to maintain the reactor more nearly at its ideal reactivity and flux distribution with the rods fully withdrawn. The patterning of the control rods will then become an easier problem, although control of the flux distribution across the reactor will always be essential to a high degree of efficiency. Fig. 5 shows a



GAS CONDITIONS
REACTOR OUTLET 306 DEG C 94½ p.s.i.g.
" INLET 140 "
FLOW IN EACH OF THE 4 GAS CIRCUITS 457 lb/sec

Fig. 5.—Heat balance diagram showing the conditions at which No. 1 Reactor at Calder Hall was stabilised

STEAM CONDITIONS AT TURBINE INLET

	TURBINE/ALTERNATOR		
No.1	"	H.P. 89 p.s.i.g.	536 DEG F
	"	L.P. 18 "	340 "
No.2	"	H.P. 100 "	538 "
	"	L.P. 16·5 "	335 "

flowsheet of the conditions at which No. 1 Reactor at Calder Hall was stabilised, and it is interesting to compare this operation at part load with the full design figure.

Having settled the reactor out with a satisfactory operating pattern, it is interesting to note that there is considerably greater flexibility in the variation of load than might be expected. A complete shut-down and allowing the reactor to drop in temperature involves a fairly slow cycle, both on the downward and upward legs, and if depressurising and charging is also involved the time goes up to the order of days. It has been found that changes to part load, keeping the temperature across the reactor constant and varying the gas flow to meet the part load conditions, can be very easily and quickly met. This may have considerable bearing on the use and value of nuclear power stations in areas where the full output of the station cannot be absorbed as a base load.

Radiation

In nuclear power stations it is necessary to be aware of and take appropriate steps to deal with radiation. Under normal operating conditions the aim is to reduce the radiation in all operating areas so that it is well below a figure which might cause any difficulty whatsoever, and constant monitoring of the entire station is carried out to ensure that these conditions are being maintained and to give an immediate warning if any of them ceases to be met. Where, during commissioning, signs of a perceptible radiation level have been detected, arrangements have been made to install additional shielding so that in the normal operating areas it is reduced to a negligible amount.

There are, however, some phases of the operation cycle when it is impossible to avoid men working in places where the radiation level may be high. This particularly applies to charge and discharge periods, when the irradiated metal is being moved out from the reactor for dispatch to Windscale. During these phases the normal precautions are taken for ensuring that men do not get any serious dosage of radiation and that any contamination is retained inside the plant area. Changing rooms are provided where special clothing is put on before the men move into an area where any possible contamination may be present, and a strict monitoring routine by badges and portable detectors is carried out throughout the operation. In particular, if any maintenance work is necessary on items which have been inside the reactor, the possibility of a fair radiation level is always present, so arrangements have been made for a maintenance area inside the control barriers where any work on possibly active materials could take place under controlled conditions, and there is, therefore, no need to move any contaminated items out into the normal working areas of the plant.

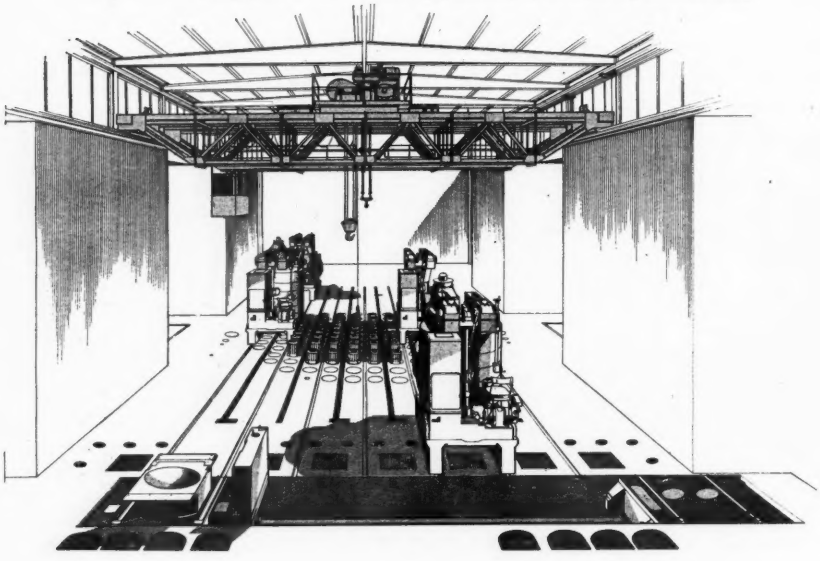
Operating Cycle

From the point of view of efficiency of power generation, the main consideration in determining the operating cycle of the plant is the reliability of the fuel elements. Clearly, as long as it is necessary to shut down to recharge the longer the life of the fuel element the less the shut-down time and, therefore, the more efficient the station, while a long element life is also essential for reducing the re-processing costs on the elements even if charging on load is possible. Fig. 6 shows a diagram of the charge floor indicating the routine which is adopted during a discharge and charge cycle. As each charge tube is prepared in turn a discharge machine first traverses over it, removes 24 elements and traverses back to the discharge side, where it is moved over the discharge well and the irradiated elements dropped into a container to take them to Windscale. While the discharge machine is getting rid of the irradiated elements a charge machine advances and refills the discharged channels with fresh uranium. A constant shuttle service is maintained throughout the recharging cycle.

It will be appreciated that where work must be carried out with the reactor shut down a very high degree of reliability is essential from all the equipment involved as, should any of it break down and delay the operation, the shut-down time of the plant will be extended. In addition, as some of the machines, such as the discharge machines, are handling active material, they must be very fully enclosed in shielding. The whole cycle of operation of the machines is then carried out "blind," so it is essential that they should be capable of going through a very large number of operation cycles perfectly without needing adjustment or maintenance.

The difficulty of access under normal operating conditions and the need for long operating runs to justify the high capital costs of a nuclear power station mean that a very high degree of reliability is essential from any mechanisms connected with the reactor circuit, as the opportunities for maintenance are extremely limited. Any of the essential operating equipment of the reactor can be maintained only either during a shut-down, by removing it at a shut-down and replacing it, or by operating for a period at part load. It is, therefore, essential to develop units with an extremely high degree of reliability under operating conditions so that adequate maintenance can be carried out during the infrequent short periods available.

Fig. 6.—The charge floor at Calder Hall. (By courtesy of Strachan & Henshaw, Ltd.)



Although the ability to maintain the reactor under normal conditions is limited, it is important that accessibility to any part should be provided, so that in the event of a serious defect being detected it is possible to get in and carry out maintenance or repair operations, even if only for a very limited period. This has been done at Calder Hall so that, if necessary, access can still be obtained even to the reactor core during a shut-down period. As such access is still limited by the radiation levels involved, a considerable effort has been put into the development of remote handling and maintaining devices and suitable viewing arrangements, so that as much of the work as possible can be carried out by men working well outside the area of radiation.

Inspection

Special inspection techniques have also had to be developed because of the inaccessibility of the reactor vessel itself for normal regular inspection. This inaccessibility remains to a certain extent even if the reactor has been shut down for a considerable period, due to the long half-life of some of the activity induced, particularly in the steel. At Calder Hall, arrangements have been made for the installation of a large number of specimens cut either from steel used for fabricating the vessel or from weld metal which has been deposited in the fabricating process.

These have been machined to size, and both stressed and unstressed specimens are installed in the reactor. Sufficient are available for withdrawing a number at the periods equivalent to normal inspections, and it is hoped that the remote viewing devices plus the information obtained from testing these specimens will be adequate to enable a very clear picture of the condition of the shell to be obtained. In addition, the strict operating conditions maintained on the plant for ensuring that during load changing no undue thermal stresses are raised in the reactor, and for monitoring the coolant circuit so that corrosive conditions do not arise, should enable the vessel to be safely operated for a reasonable working life.

Chemical Processing of Nuclear Fuels

IN a paper presented at a meeting of the Institution of Chemical Engineers held in conjunction with the British Nuclear Energy Conference on 21st February, it was pointed out by Messrs. C. M. Nicholls and R. Spence that the requirements of the nuclear reactors used for the production of fissile material for atomic weapons and for the generation of electricity were radically different. The former used natural uranium, operated at comparatively low temperatures and the fuel was irradiated for a short time only in order to obtain the maximum yield of plutonium 239. In power reactors, on the other hand, the temperatures ranged from 300 deg C upward and long irradiation times with high " burn up " of the fissile material were favoured, in order to improve the economy. The fuel was withdrawn for chemical processing to maintain its performance at some set level and it was unnecessary to achieve the extremely high decontamination from fission products, which was attained in military production plants.

Solvent Processes

Many different solvent processes, which were potentially applicable to power reactors, had been devised and were described at the International Conference on the Peaceful Uses of Atomic Energy at Geneva in 1955. The most important recent development had been the introduction of the solvent tributyl phosphate, which was used as a solution in kerosene. Methods based on the use of ion-exchangers, such as thiophenoyl trifluoro acetone had been examined in many laboratories, but did not appear to offer any advantages over solvent extraction. Fluorination processes already played an important part in atomic energy operations, but their application was rather restricted as their many attractive features were counterbalanced by the cost and hazardous nature of the reagents and by such problems as corrosion and criticality.

Chemical processing was profoundly affected by the nature of the reactor fuel cycle, which ranged from those in which the " burn up " was so high that the fuel could be discarded without processing to those in which it, in an otherwise efficient reactor, was so low that several processing cycles might be justified. Since, however, the processing cost per kilogram of fissile material was an inverse function of the throughput, the reduction in the overall cost accompanying an increase in the irradiation time would not be so great as might at first sight be expected. A consequential result of interest was that the processing costs per unit of electrical power generated tended to decrease only slowly with an increase in radiation time beyond about 4,000 MW days per tonne.

Layout Requirements

The layout of a radioactive plant was extremely important, as it was necessary to operate and maintain it and to take samples from within heavily shielded cells. In the separation plants at Hanford provision was made for the remote replacement of the major components, while the primary separation section of the Windscale plant was designed to operate without access for maintenance, whether direct or by remote control. Experience had, however, shown that the latter plant could be decontaminated to such an extent that access for maintenance could be obtained. It was possible that in future there would be a compromise between these extremes. Provision might be made for the remote replacement of special parts and there would be arrangements for access after decontamination. This would be facilitated if sections of the plant were segregated in separately shielded cells and if a common route of approach was provided.

Substantial Economies Possible

The characteristics of the processes described in the paper had been dealt with as if they were all commercially operable in appropriate circumstances. In fact, the only adequate processes which had been operated on an industrial scale were of the solvent extraction type. As a result of experience, substantial economies could be visualised in future plants of this kind, particularly if the throughputs were larger. Another factor which was likely to strengthen the case for solvent extraction processes was the unsettled state of fuel element design. Almost any variety of solid fuel of a given general type could be accepted for treatment in a solvent extraction plant, provided suitable modifications could be made at the de-canning and dissolving stages. Nevertheless,

instances might arise where some form of process was more appropriate, such as the need for a short decay period in the case of plutonium fuel from fast reactors. Here the saving in fissile material arising from this shorter period must be more than sufficient to cover the extra cost of the gamma active fuel element fabrication which would be required if a high-temperature separation process was used.

In certain types of reactor using liquid fuel it was proposed to separate the fission products by means of a process which was an integral part of the reactor fuel circuit. In this case the advantages to be obtained in neutron economy from the rapid elimination of fission product poisons must be set against the higher processing cost in a small plant. Clearly, only the simplest kind of operation which could be easily accommodated in the reactor ensemble would be feasible. Where a number of such reactors were grouped together at a large power station a single, more elaborate, processing unit might serve them all. In this case it might also be worth while to install the blanket processing plant and any additional facilities for the periodical complete recovery of the core fluid on the same site. As the number of stations generating electricity from nuclear reactors increased these questions would become more important; and it was probable that owing to the complexity of the technical and economic factors, each situation would demand its individual solution.

DISCUSSION

The discussion on the paper was opened by the chairman, Mr. K. B. Ross, who said that he tried to look at the process from the viewpoint of the operator on the plant floor. The remote control of liquid-liquid extraction was frightening, but if it was necessary it would be done. The analytical control of the products going into and coming out of the process played an important part in enabling the operation to be kept within the criticality limits. At Windscale they were now getting ready to make their first large assault on the problem of the possibility of decontaminating plants.

Mr. J. P. Asquith said that one could not but admire the technical skill shown in designing and bringing into operation a plant based on such limited data. All accepted the need for versatility, but he wondered whether it was to be achieved solely on the basis of the solvent extraction process. It seemed that useful results could be obtained from relatively simple metallurgical processes. It was difficult to find what was the relationship, either economic or technical, between the size of the power output and the treatment plant. When Windscale was designed, a great deal of spare capacity was built into it. There must come a point, however, when Windscale had no spare capacity. If one had an extending programme of fuel reactors and there were a number of different types of reactors, was versatility in the treatment of fuel related in any way to the economic size of the fuel production unit?

Mr. Nicholls agreed that there was scope for the study of a wide range of processes; but the cost of high-temperature processes had to be considered, and some of these " relatively simple " operations became extremely complex. In relation to the reactors, the extraction plants had an enormous capacity. These plants could become much bigger, but it would not be known how big they could become until a nuclear power industry had grown up.

Prof. A. M. Kay said that a large number of reactors of the Calder Hall type would be built. If at some stage there was a change to an oxide or carbide fuel, what effect would this have on the chemical processing problem?

Mr. Nicholls replied that the signs were that the oxides and carbides, the fuels favoured in the near future, would fit into the process very easily. The handling of chlorine trichloride, to which reference had also been made in the discussion, could be made safe provided the operators knew the rules and kept to them.

Mr. T. G. Hughes was glad that the authors had come down firmly in favour of the solvent extracting process. The paper appeared at an appropriate time because it was five years almost to the week since the primary extraction plant at Windscale went into operation. Fears felt at the time had generally proved unfounded. The plant had worked very well and with modifications it could process for two Windscale reactors and eight Calder Hall reactors.

Mr. R. Spence, co-author, commented that the general problem of what was to be done in the future was one that exercised them seriously. They tried to look critically at all possible processes, but it had to be remembered that, especially in regard to atomic power, it was necessary to sell these things in a world of hard cash, unlike the " old days " when anything which " went " could be sold. In future one could only expect a process to be incorporated into a nuclear power scheme if it gave a real reduction in costs over existing techniques. The present type of reactor would go on for a long time, but undoubtedly others would come along. He told Mr. R. G. Tongue that at present the wet processing was responsible for the smaller fraction of the cost of the operation.

Dr. Brady (U.S. Atomic Energy Commission) contributed a short historical comment, and the discussion was concluded by the chairman, who said he was glad the consensus of opinion was that the liquid-liquid extraction process would continue.

Electroluminescence

PROGRESS in the field of electroluminescence, by the production of light from a phosphor powder which is subjected to the direct action of an electrical field, was described by Mr. J. N. Bowtell, B.Sc., A.Inst.P., of the G.E.C. Research Laboratories, to the members of the Liverpool Centre of the Illuminating Engineering Society, on 19th February.

Mr. Bowtell said that electroluminescence had found limited practical application in certain special fields of illumination, but it was unlikely that electroluminescent devices would be used as conventional light sources, owing to the relatively low luminous efficiency and brightness. One lamp which he produced and demonstrated was said to be the lowest powered lamp ever made; its consumption was rated at one-tenth of a watt.

The life of electroluminescent devices was several thousand hours, but lumen maintenance was not yet as good as that of conventional light sources. The brightness increased markedly with frequency and values of 50 foot-lamberts had been obtained by these means.

Green electroluminescent panels were being used as safe-lights in photographic dark rooms and a small scale production of panels for this purpose had been in progress in this country for about three years. Panels had also been used to a limited extent as direction signs and for the marking of obstructions. Electroluminescent bulbs which looked like normal household filament lamps and which used the same type of cap, might be put into any normal b.c. holder connected to an appropriate a.c. supply. They were convenient to use where a low power source, such as a night light or indicator lamp, was required. In the United States electroluminescence was used for image intensifiers for television. Future television receivers might well consist of a screen about the thickness of a picture frame fixed to the wall.

Butyl Rubber for Dielectrics

By B. B. EVANS, B.Sc., F.R.I.C., F.I.R.I.,*
AND
J. B. DYKES, B.Sc., A.I.R.I.*

Survey of Physical and Electrical Properties

ISOBUTYLENE is one of the numerous gaseous hydrocarbons which can be produced by "cracking" petroleum under suitable conditions. It can be polymerised to form a long chain high polymer with some rubber-like properties known as polyisobutylene (p.i.b.) and this material has been marketed for some ten to fifteen years under various trade names. It is a hydrocarbon and is what a chemist terms "fully saturated," which means that it is extremely unreactive chemically.

While this lack of reactivity is valuable in that it means that p.i.b. is very resistant to ozone and oxygen, it is a disadvantage because the material cannot be made to undergo the chemical reaction known as vulcanisation by means of which it would be converted from a plastic to an elastic product. So long as the material remained thermoplastic it was obvious that its use would be limited as in this form it is extremely soft, but that if it could be made vulcanisable one would have a "rubber" with most interesting and useful properties.

This problem was solved by mixing the isobutylene with a small quantity, between one and four per cent, of isoprene (the basic monomer of natural rubber as formed in the tree) and then copolymerising the two. This copolymer of isobutylene and isoprene is known as butyl rubber. It follows, therefore, that basically butyl rubber is polyisobutylene in which the undesirable features of thermoplasticity are largely overcome while maintaining the desirable properties of resistance to heat, moisture, and ozone.

Although butyl rubber can be vulcanised, the proportion of vulcanisable polymer is between one and four per cent of the total. From this it follows that the material does not vulcanise so readily as natural rubber and to make it vulcanise it is necessary to use relatively high proportions of fairly expensive organic compounds. This is one reason why, although raw butyl rubber is cheaper than raw natural rubber, a butyl compound is more expensive than a similar natural rubber one. A second contributory factor which helps to make vulcanised butyl rubber dielectric more expensive than a similar one of natural rubber is that the rate of vulcanisation is much lower. A feature of vulcanised butyl rubber which is of value in vehicle tyres but a disadvantage in cable manufacture is its high impermeability to air. It will be obvious that if, as is often the case, a certain amount of air becomes entrapped in the compound during processing it will not readily escape, so that although butyl rubber is mixed and processed in much the same way as natural rubber, the necessary modifications again tend to increase costs.

As butyl rubber is a hydrocarbon, like natural rubber, it resembles natural rubber in some respects. The electrical properties are very good but it has little fire resistance and if ignited it will not be self-extinguishing. Owing to the small amount of unsaturated hydrocarbon, it is not possible to build up such a highly cross-linked structure during vulcanisation. As a result, vulcanised butyl rubber dielectrics have not the high elasticity of those made from natural rubber, they are less robust, and have a lower tensile strength. Whereas the tensile strength of a dielectric containing, say, 60 per cent by volume of natural rubber would be of the order of 1,200 to 1,600 lb/sq in, that of a similar butyl dielectric would be about 600 to 800 lb/sq in. In America, butyl rubber has reached the stage where published specifications exist for controlling its quality, and these require that the tensile strength of a vulcanised butyl dielectric shall be not less than only 600 lb/sq in.

Resistance to Oxidation

Fig. 1 shows a comparison of the retention of initial physical properties by both a natural rubber dielectric and a butyl rubber dielectric when stored at 100 deg C in air and at atmospheric pressure. The butyl rubber retains its properties very much better, this being due to its resistance to oxidation which, as has already been indicated, is in its turn because butyl rubber contains only a very small percentage of reactive material. Again the American specifications referred to above contain heat-resisting requirements which are much more severe than can be applied to natural rubber dielectrics and are intended to ensure that the butyl compounds are so formulated as to take advantage of the heat resistance. Thus, one requirement is that after seven days' storage at 100 deg C in air and at atmospheric pressure the compound shall have retained not less than 60 per cent of both the initial tensile strength and the initial elongation at break.

Another test is what has become termed the "air

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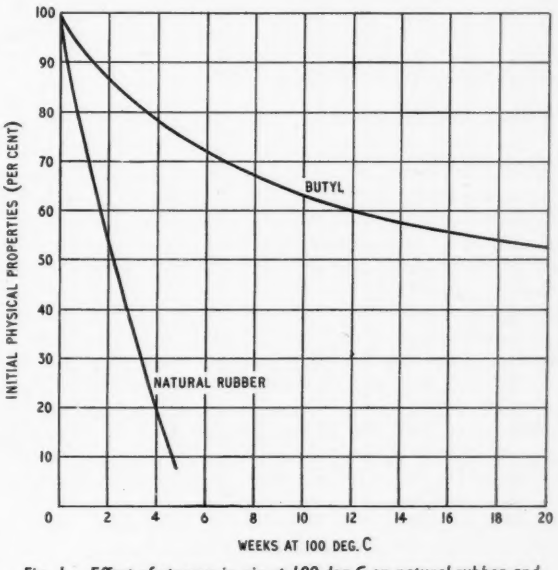


Fig. 1.—Effect of storage in air at 100 deg C on natural rubber and butyl rubber

bomb" test. In this the sample is stored in a steel container at a temperature of 127 deg C and under an air pressure of 80 lb/sq in. The specifications require that after twenty hours of such treatment the dielectric again shall retain not less than 60 per cent of its initial tensile strength and initial elongation at break. A conventional natural rubber dielectric would not be able to meet either of the above requirements. From a considerable amount of experimental work carried out in America and confirmed in this country, it has been agreed that butyl dielectrics of a type which will meet the above heat-ageing requirements are suitable for continued use at conductor temperatures of the order of 80 to 85 deg C. The question naturally arises as to what practical use can be made of this conclusion.

So far as small wiring size cables up to, say, 7/·029in are concerned, the conductor size is determined by voltage drop considerations. It seems that in these cases butyl rubber insulated cables would not be used at higher current ratings, but with existing ratings at higher ambient temperatures, for which natural rubber dielectrics would not be suitable. For sizes of, say, 7/·036in and above, advantage can be taken of the heat resistance of butyl rubber to increase current ratings, and there seems no doubt that butyl rubber insulated cables can be rated the same as varnished cambric types.

The prime cost of a butyl insulated cable may be somewhat higher than that of a varnished cambric type but as butyl rubber is, if anything, even more resistant to moisture than is natural rubber, it is clear that no special end sealing would be necessary, so that the overall cost of an installation in butyl insulated cables might be less than with varnished cambric insulated. Now that we have a dielectric capable of operating with a conductor temperature of 80 to 85 deg C it is obvious that some thought will have to be given to outside coverings. Thus, conventional wax compounds as used on conduit wiring cables would melt at a conductor temperature of 80 deg C.

Many types of cables have a neoprene sheath. A neoprene sheath on a core at a temperature of 80 deg C would in due course become hard, and it seems logical, therefore, that a butyl insulated cable with a lead sheath could be rated higher than a butyl insulated cable with, say, a neoprene sheath. Although the full implications of the heat resistance of butyl rubber have not yet been worked out, it is obvious that there is likely to be lively competition between butyl rubber insulated cables and the existing varnished cambric types.

Moisture Resistance

We are apt to regard natural rubber as being waterproof, but scientifically speaking this is not so, because natural rubber, by its method of preparation, contains a small quantity (about five per cent) of non-rubber bodies derived from the latex but not completely removed from the coagulated rubber by the subsequent washing and drying treatment. On the other hand, the method by which butyl rubber is polymerised is such that the butyl rubber is an extremely pure hydrocarbon; hence it is very resistant to moisture, and provided this is not spoilt in compound formulation, the resulting butyl compound will absorb considerably less moisture than a natural rubber one. Thus, if a natural rubber dielectric is immersed in distilled water for seven days at 70 deg C it will absorb something of the order of 20-30 mg/sq in of surface exposed, whereas a similar butyl dielectric will absorb something of the order of 10-20 mg/sq in.

American specifications require that the amount of water absorbed shall not exceed 15 mg, although it seems likely that this requirement has in mind high-voltage cables, whereas it is obvious that if one were using a low-voltage butyl insulated cable as a replacement for, say, varnished cambric there would be no technical reason why it need be more moisture resisting than natural rubber, and for such purposes there seems little doubt that a moisture absorption of, say, 20 mg/sq in could be allowed with safety.

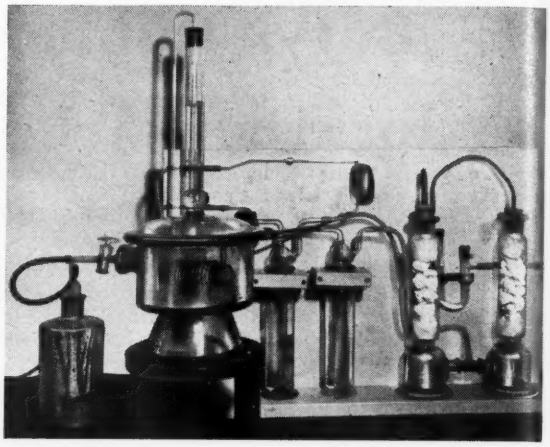


Fig. 2.—Apparatus for demonstration of ozone resistance of butyl rubber dielectrics

Reference has already been made to the lively competition which may be expected between varnished cambric cables and those insulated with butyl rubber. One big application for varnished cambric at present is for ship wiring, and it is of interest that Lloyd's have signified their acceptance of a butyl rubber dielectric having the physical and heat-resisting properties referred to earlier, combined with a moisture absorption of not more than 15 mg/sq in when determined by the method outlined.

Ozone Resistance

The ozone resistance of butyl rubber dielectrics can be demonstrated by means of an apparatus of the type shown in Fig. 2. Air is dried by being passed over calcium chloride and through concentrated sulphuric acid in drying towers, then through an ozoniser (not shown) and then into the exposure chamber. The concentration of ozone can be varied, but for testing butyl rubber the specified concentration lies between 0·025 and 0·030 per cent.

If a natural rubber insulated core is bent round a mandrel having a diameter about five times that of the core, the dielectric will show pronounced cracks in a matter of minutes, whereas a butyl rubber dielectric will remain uncracked, and is in fact required to remain uncracked, for at least three hours. This resistance to ozone combined with good electric properties, moisture resistance and heat resistance, indicates an obvious field for high-voltage cables, and some typical results obtained from experimental high-voltage cables made with butyl rubber may be of interest.

A 19/·064in tinned copper strand was insulated with a typical butyl rubber compound, having a permittivity of about 3·5; the radial thickness of dielectric was 0·178in, which is slightly less than specified in B.S. 7 for 6·6 kV natural rubber cables. The sample withstood a typical B.S. 7 pressure test of 18 kV for fifteen minutes; immersion in water was continued and 20 kV 50 c/s applied continuously, this being about four times the

nominal working voltage. The length withstood this satisfactorily for over 100 hours.

In another case a length of 19/·064in tinned copper was insulated with a typical butyl rubber compound to a radial thickness of 0·208in. The core was screened by an application of "Aquadag" and one coat of copper foil. The length was then fitted with end cones and 6in long guards for power factor measurements. The sample was connected to a 1,000 c/s plant and was given daily heat cycles to a maximum conductor temperature of 85 deg C, the cycle consisting of six hours heating and eighteen hours cooling together with a superimposed voltage of 9·6 kV at 1,000 c/s.

The 1,000 c/s technique has been applied in the Henley research laboratories as a means of accelerating any deterioration which may occur in a cable dielectric due to electrical discharges in any gaseous voids present in the dielectric. The power factor (cold) at the start of the test was 0·0076 at 6 kV but rapidly improved to about 0·0050 after four heat cycles. This improvement was maintained until the test was stopped after 50 heat cycles and 1,488 hours on voltage. The power factor of the hot cable showed a similar improvement from 0·101 to about 0·0070. The total ionisation from 3 kV to 12 kV after the eleventh heat cycle never exceeded 0·0003. If it is assumed that the rate of deterioration is proportional to the frequency, the above test period would represent about 3½ years' use at 50 c/s.

It is clear that technically, butyl rubber has electrical properties which are of interest up to about 15 kV, combined with heat resistance which enables it to operate at a conductor temperature of about 80 deg C. Although the dielectric thicknesses are likely to be greater than for impregnated paper and the cable correspondingly more expensive, again ends and joints may be cheaper than with impregnated paper cables.

The foregoing survey shows that in butyl rubber we have a further man-made material with most interesting technical properties. Its use will naturally depend on its cost relative to the existing materials with which it can compete technically. The necessary development work has been carried out within the Henley organisation.

Electricity Bill in Committee

Generation by Area Boards—Trading Activities—Financing Rural Electrification

WHEN consideration of the Electricity Bill was resumed by a committee of the House of Commons last week, Mr. Reginald Maudling, Paymaster General, replied to the debate on the motion that Clause 3 should stand part of the Bill. He said the main criticism had been that the Electricity Council would be overweighted numerically by the Area Board chairmen, but he thought it essential that they should all be on the Council. One of the main purposes of the Bill was to make each Board responsible for running its own show and paying its way. In those circumstances it would be wrong to differentiate between one Area Board chairman and another. To some extent the balance would be affected by the amendments which he had already accepted on behalf of the Government and the other suggestions which he had undertaken to consider.

Mr. Nabarro interrupted to say that he would withdraw his objection to all the Area Board chairmen being on the Council if the Minister did not consider the Council would be too big if, say, 24 people were on it.

Mr. Maudling said he did not think that would be too many or that there should be an absolute limit. He agreed with those who had stressed the importance of personnel training, the interchange between the various Area Boards, and the creating of a proper careers system. But it would be wrong to write into the Bill any statutory provision for such a central personnel organisation. The Council was given power under sub-section 4 of this Clause to run a central personnel organisation on behalf of all the Boards, or of those who wished the Council to do so. The Government had considered including a reference to training, education and interchange of personnel but had been advised by counsel that it would prejudice the generality of the sub-section. The Minister of Power could make it clear that in his appointments of senior members in the industry he would have regard to the breadth of their experience in the industry.

The Government had not accepted an amendment about appointing a member who would have had knowledge and experience in the organisation of workers, but it was clear from the appointments that they had recently made to all the nationalised industries that they attached great importance to such people.

Concerning the powers that should be given to the central authority, the Herbert Committee stressed the importance of local autonomy but its proposals for the central authority seemed to deny just that local freedom and responsibility for which it had argued so strongly. By their proposals the Government had achieved the best possible balance by leaving as much responsibility and authority as they could to the Area Boards, while providing a central body of great power and great distinction which would be able to provide an opportunity for the co-ordination of the views of the various organs of the industry, and for giving authoritative advice to the Minister.

The Clause was approved.

On Clause 5 ("Generation of Electricity by the Area Boards"), Mr. Hobson moved an amendment to provide that an Area Board should not generate electricity without the consent of the Electricity Council, instead of having merely to consult with the Council. He said this Clause made it legally possible for Area Boards to generate electricity, although he could not visualise circumstances in which this would be necessary and he knew of no Area Board which did so now. There should be some reason stated for including this Clause in the Bill.

The Committee also discussed an amendment by Mr. Fort which coupled with generation "the sale of heat obtained from, or in connection with, such generation." He said that such a power was conferred by the 1947 Act on the C.E.A. but he could not find it continued in this Bill.

Mr. Maudling said Mr. Fort's amendment was unnecessary because the Area Boards would have the power not only to generate electricity for distribution but also to

sell the heat that was created in the process of that generation. In introducing this Clause the Government had in mind the provision of district heating schemes by Area Boards and the possibility of small-scale thermal stations to meet local difficulties of peak demand. The Area Boards might be able to meet such demands more conveniently than the central generating system. There were particular problems which might arise in some rural areas where small-scale local generation might well prove more economic than transmission for long distances from the main system. Particularly there was the possibility—no doubt some years ahead—of small-scale nuclear reactors for rural purposes. Thus it would be a wise provision to enable Area Boards in certain circumstances to generate locally.

In general there was no question that, as a matter of economy, small-scale generation by the Area Boards would compete with the vast scale of the central generating authority, so the Government sought to put some limitation on the Boards by saying that they should first consult with the Council and submit proposals to the Minister for his approval with or without modification. It was going a little too far, as Mr. Hobson's amendment proposed, to place the power of veto with the Electricity Council because the principle on which the Government were operating was that the Boards should have autonomy.

Mr. Palmer said the Opposition considered it very valuable that the Area Boards should have power to generate, but only on a limited scale. The reason for their amendment was that the power was drawn too widely and that the ambitious Area Board chairman might say "Here is the opportunity to build up a generating scheme all on my own," in that way destroying the co-ordinated system of bulk generation and transmission which was in the general interests of the industry and the country. The Opposition thought that the Council should be given wider powers over the industry generally.

Mr. Warbey thought it was possible to envisage Area Boards being offered a nuclear power station of up to, say, 50 MW of the more advanced type and being able to undercut the Generating Board. Such activities should not be engaged in without the consent of the Electricity Council.

The amendment was withdrawn.

Effect of Special Powers

Mr. Palmer moved an amendment to ensure that nothing in the Clause should be construed as limiting or varying the duty of the Generating Board to develop and maintain an efficient co-ordinated and economical system of supply of electricity in bulk for all parts of England and Wales. He said the Opposition were anxious to ensure that this duty should not be upset in any way by the special powers now being given to the Area Boards to generate electricity.

Mr. Renton, Parliamentary Secretary, Ministry of Power, said that this was one of the problems which could be solved only by commonsense on the part of all concerned and it would be difficult to legislate for it. The Electricity Council and the Minister were not likely to advise or give approval for an Area Board generating scheme if it were to be a serious incursion on the Generating Board's duties of bulk transmission and generation. The exercise of the Area Board's power was to be in exceptional cases only.

The amendment was negatived by 19 votes to 14.

On Clause 6 ("Research"), Mr. Fort moved an amendment to provide that the Electricity Council, the Generating Board and the Area Boards should publish the results of their research studies into the use of electricity by different classes of consumers—domestic, farming, industrial, commercial and so on—as was done extensively in the United States. The C.E.A. had sat tight on the results of its utilisation research with a secrecy which made the Atomic Energy Authority—in all but the deepest defence secrets—appear positively open-handed. One could find in the technical Press more about the costing for power from nuclear reactors than could be found about the electricity side, particularly concerning generation.

Mr. Palmer said he believed in full freedom for research and the publication of results, but this was an imperfect world and much research was done in secrecy. People like himself who were engineers professionally found in such journals as that of the Institution of Electrical Engineers many papers written by eminent engineers, including those employed by the C.E.A. and the Area Boards. In addition the C.E.A. and the Area Boards were members of the Electrical Research Association which published many papers. The Herbert Committee had been completely wrong and most unfair to the supply industry. Were the solid fuel manufacturers and the gas industry to keep their dark secrets to themselves, while the poor electricity industry was compelled to publish everything? The amendment should be rejected as being grossly unfair to the competitive efficiency of the electricity supply industry.

Mr. Renton said that all would agree that generally it was important that the results of useful research should be published but the amendment would *oblige* the Council to publish the results and the Government did not wish to legislate in that sense. There were secrets which legitimately needed to be retained. Moreover, sometimes research did not produce fruitful results.

The amendment was withdrawn.

Boards' Retail Trading Activities

As briefly reported in last week's issue, when Clause 7 ("Powers of Minister in Relation to Electricity Council and Electricity Boards") was discussed Mr. Maudling gave an assurance that the powers in the Bill would not be used to prevent the Area Boards from carrying on their retail trading activities.

Mr. Palmer had moved an amendment to provide that nothing in the Clause should authorise the Minister to give a direction requiring an Area Board to dispose of premises, plant or equipment used by that Board for the purposes of retail distribution of electrical equipment, or the servicing or maintenance of such equipment. He said the Opposition were conscious of the campaign being waged in some quarters against the retail trading activities of the Area Boards and this propaganda might grow in volume. The Opposition believed that all the Area Boards should engage in retail trade in electrical appliances. It was a traditional practice dating back long before 1947. To limit that right and to talk about closing down showrooms and preventing the publicly-owned supply industry from retail trading in appliances and in contracting was a backward step. By maintaining standards the public service greatly helped everyone, and the general technical progress of the industry.

Mr. Maudling replied that the purpose of the Clause was very limited; it did not go as far as Mr. Palmer feared. It was intended to deal with such things as houses requisitioned by statutory undertakers during the war. The power to sell fittings was retained. He could assure the Opposition that the Government had no intention of using the Clause to put a general ban on retail trading in appliances by the Area Boards but, on the other hand, he could not accept the amendment because it would

unreasonably confine the power of the Minister which at present enabled him to direct any Board, after consultation with the Council, as to the use or disposal of assets not connected with generation, transmission or distribution.

When the debate was resumed on 28th February Mr. Maudling said the Clause reproduced exactly what was in the 1947 Act. The Area Boards had the power to sell and supply fittings and to carry on contracting work under Section 2 (4) of the 1947 Act and nothing in the present Bill in any way affected that power or took it away.

Mr. Du Cann said that private retailers and electrical contractors in his constituency (Taunton) complained that they could not compete against the bulk buying activities of the Area Board and could not match the terms on which goods were offered out on hire. It was right for the Minister to reserve to himself powers to curtail the activities of the Boards if they appeared to be unfair in any way. For the Area Boards to expand their activities in this way was nationalisation by stealth.

Mr. Palmer said that if Mr. Du Cann's view coincided with that of the Government the Opposition were right to be suspicious. They wanted to ensure that the traditional and harmonious co-operation between the Area Boards and the private firms was not ended. They felt inclined to accept the assurance of the Minister.

The amendment was, by leave, withdrawn.

Boards' Capital Programmes

On the same Clause Mr. Palmer moved an amendment to ensure that the capital programmes of the Area Boards should be settled by the Electricity Council. He said the amendment would ensure that instead of the Boards putting up their capital plans separately there would be a single capital programme worked out by the Council and put before the Minister. To allow the Boards to go ahead with their own plans would be an arrangement which would weaken the voice of the industry in relation to the national economic planning. If it was to be the responsibility of the Council to make stock issues and raise loans for the whole of the industry it was inconsistent not to give the Council responsibility for the organisation and planning of the whole capital programme.

Mr. Renton said it would not be inconsistent because the raising of stock would follow the decisions of the Area Boards and of the Minister. In Clauses 14 and 15 the Council was not given executive power to raise loans but to perform common services on behalf of the Boards. It was essential to their autonomy that the Boards should be allowed to take decisions on their programmes although the final decision would rest with the Minister.

The amendment was negatived by 19 votes to 11.

Mr. Palmer moved an amendment to Clause 8 to provide that in their annual report the Electricity Council should include a general review of the activities of the Council, the Generating Board and the Area Boards.

Mr. Maudling said the Government agreed with the amendment and would include it, with slightly improved wording, at a later stage.

The amendment was withdrawn, although Mr. Palmer added a request that the annual reports should be in a shorter and more easily digested form than at present.

Joint Consultation

On Clause 9 (" Machinery for Settling Terms and Conditions of Employment "), Mr. Palmer moved the first of a series of amendments to make the Electricity Council responsible for joint consultation on safety, health and welfare as would be the case in respect of wages. The Government's proposal to give the Council and each Electricity Board power to conduct consultation concerning measures for safety, health and welfare was an unsatisfactory departure from the principle of national responsibility, he said. It could mean that there would be 14 separate agreements instead of a national agreement and there was the additional complication that the Generating Board had 12 Divisions. This might mean that they would have to make separate agreements for each Division. The General Council of the Trade Union Congress had expressed the firm conviction that the joint consultation should remain on the present, national basis.

Mr. Maudling said the Government wanted to meet the Opposition on this point. The Herbert Committee had suggested that there were minor matters which could more appropriately be dealt with at the local rather than the national level. The beginning of the Clause stated that the existing national machinery for negotiation would be continued but paragraph (*b*) provided that where an Area Board and the trade unions agreed that some variation in the way of a local arrangement would be advantageous, this could be done locally. He was not closing his mind to this amendment; he only wanted to get the most effective negotiating machinery. He would consider the matter further.

Capt. Mark Hewitson said that although the Minister's remarks were helpful, the fact remained that this subsection would be " dynamite " in the industry. It might be argued that the words in the Bill were similar to those in the Gas Act but the circumstances in the two industries were entirely different. He said that at the national officer level he was handling the industry on behalf of the unions concerned, and he besought the Minister to retain the *status quo* and not to wreck a good industry.

Mr. Maudling said he was very impressed by Capt. Hewitson's speech. It was most convincing, and he much appreciated that the unions might be able to help with advice. He therefore gave an undertaking that he would reconsider this matter before the Report Stage.

Mr. Palmer moved an amendment to include education and training, as well as safety, health and welfare, in the scope of the joint consultative machinery. This was agreed to.

Rural Electrification

On Clause 10 (" General Duty of Boards to Balance Revenue Account "), Mr. Palmer moved an amendment to exclude rural electrification from the activities in which the Area Boards were expected to pay their way. It was discussed in association with a proposed new Clause (" Rural Electrification Fund ") which states:—

> " The Electricity Council shall prepare and submit to the Minister a scheme for the purpose of enabling Area Boards to carry out the duties imposed upon them by section 1 (6) (*b*) of the principal Act and providing for the establishment of a fund to be known as the rural electrification fund. Any Area Board which establishes to the satisfaction of the Electricity Council that it has incurred special financial burdens in connection with securing the extension to rural areas of supplies of electricity shall be entitled to draw upon the rural electrification fund to such extent and under such conditions as may be authorised by the scheme."

Mr. Palmer said that Section 1 (6) (*b*) of the 1947 Act, which was continued in the Bill, imposed the duty on the Area Boards to develop electricity supplies in the rural areas. It would be difficult for the Boards to meet the obligation to pay their way if they had to carry out that duty. This had been shown by the experience of the South Western Electricity Board and other Boards. The C.E.A. had taken their financial difficulties into account and decided that a certain part of the general resources

of the industry should be set aside to assist any Area Board which could show that it was in economic difficulties not because of commercial inefficiency but because it was carrying out the duty imposed in the 1947 Act to extend electricity supplies to the rural areas.

To put the situation right, the Opposition were suggesting that Parliament must separate the special duty of developing rural supplies from the duty placed on each Board to pay its way. As the new Clause showed, they proposed that there should be a nationally-financed fund for use in financing rural electrification.

Mr. Hayman confirmed the experience of the South Western Board in carrying out rural electrification. The Board had tackled it with great prescience, he said, and had carried out a five-year programme in four years, but would not be able to carry on doing this under the new arrangement unless there was some reserve of funds on which the Board could draw. There was still a great unsatisfied demand for electricity in rural Cornwall. The reports of the South Western Board provided ample justification for the new Clause which the Opposition had put down.

Mr. Fort said that he had much sympathy with the new Clause but he did not think the cost of rural electrification should be a charge on the electricity industry; it should be paid for by a charge on the Exchequer. The right way to achieve this was to bring in, by legislation, a new rural electrification grant.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

The International Ohm

IN your issue of 2nd November last Mr. E. J. Beaven asks, and in the issue of 1st February reiterates, why was mercury chosen as the material for the international ohm?

Mercury is not, as Mr. Beaven states, an erratic material, nor is it a non-linear conductor. It can readily be purified and hence is more reproducible than any alloy is likely to be. Its resistivity is high, so that a 1-ohm resistor can be made of reasonable cross-section and of reasonable length. Its temperature coefficient of resistance is low for a pure metal.

Further, it is a liquid, which can take up the form of the containing vessel, and hence a long thin resistor with massive terminals can be made without joints. For the purpose of the international ohm—which was intended to be a reproducible standard—there was no other material as suitable as mercury.

The value of the current to be used with the international ohm was not specified because it was of no consequence. Provided the current were not so large as to heat the mercury by an appreciable amount—and if it were the temperature requirements of the specification would not be met—the value of the resistor would be independent of current.

A. FELTON.

Power Factor Correction

IN connection with Mr. H. K. Hadley's article on power factor correction in the 15th February issue of the *Electrical Review*, I feel that the mystic figure of 85 per cent of the magnetising kVA, so often quoted, requires qualification. The explanation is really quite simple.

From theoretical considerations, it is safe to connect a capacitor of rating up to, but not exceeding, the full magnetising kVA of the motor to be corrected, without risk of over-correction. In practice, there is, by doing so, a distinct risk of over-correcting, because capacitors are not designed with any high degree of accuracy in respect of kVAr rating, their nature being such that makers claim a tolerance of 0 + 10 per cent on nameplate rating.

Thus a capacitor may be ordered for 100 kVAr rating, but it might arrive with the full limit of tolerance, and when connected, would give 110 kVAr of correction. To "play safe," the capacitor size should be fixed at roughly 85 per cent of the magnetising kVA of the motor, or certainly not more than 90 per cent as an optimum figure, with the firm knowledge that the apparatus will probably inject into the motor circuit a slightly greater reactive kVA than was anticipated, at the voltage specified.

The actual capacity can be checked quickly in service from a reading by tong type ammeter, and I might add that the last occasion on which I had reason to take an ammeter reading in a capacitor circuit (it happened to be a 180 kVAr h.v. unit), the result indicated a kVA figure of 10 per cent above the nameplate data.

Finally, may I say that the table given at the conclusion of the article on typical values of magnetising kVA forms a most useful practical guide, but I would like to have seen it extended to 100 h.p. or more, for purposes of quick reference.

Sheffield. F. L. PARKIN, M.I.E.E.

Employees' Protection

THE final sentence of the note dealing with a recent case on eye protection by Mr. F. E. Sugden, in your issue of 25th January, may cause misunderstanding, since it does not I think, with respect, represent the views of the Lord Chief Justice. It may also give rise to some concern and I should like to direct attention to the provisions of Section 119 (1) of the Factories Act, 1937. Put shortly, if a means or appliance are provided in pursuance of that Act for securing the health or safety of a person employed, then that person is under an obligation to use that means or appliance. There is, in fact, a dual responsibility, first upon the occupier and then upon the person employed.

Clearly, in the case under review it has been decided that the statute requires the provision of suitable eye protection for workers engaged in cutting concrete. It therefore follows that there is an obligation upon the employee to wear the equipment which has to be provided.

I suggest that when suitable safety equipment has been provided as required by the Act, and due diligence has been exercised to ensure that the employees are fully aware that it is available, the next logical step, if there is a default, might well be to take action under the terms of S.119. This would be much better, in my opinion, than arbitrary dismissal and the effect would be salutary.

I realise, of course, that in the present case no goggles were provided.

Sale, Cheshire. L. A. CORNEY,
Chartered Electrical Engineer.

VIEWS on the NEWS

By REFLECTOR

NO doubt with the Monopolies Commission's report in mind, Sir George Nelson, in proposing the health of the guests at last week's annual dinner of the Institution of Electrical Engineers, said that when 1,500 members of the Institution (out of a total of 42,000) got together, as on that evening, they were not acting against the public interest. Indeed the tenor of his speech was the way in which the Institution co-operated with other bodies represented at the dinner to promote the public interest.

Sir George referred to the presence of the Chancellor of the Duchy of Lancaster (who replied for the guests) and took it as a mark of his versatility that he was, by virtue of a typographical error, entered in the list of those present as "Hill, Dr. The Rt. Hon. Char."

* * *

An interesting point is dealt with by Dr. B. V. Bowden, principal of the Manchester College of Science and Technology, in a letter to the *Manchester Guardian*. Dr. Bowden backs the statement by that newspaper's Scientific Correspondent to the effect that electronic control mechanisms for machine tools are more highly developed than the machines to which they are attached. He says that they have been trying in the College to develop the basic elements of machine tools which will be specially suited for electronic controls.

> "We expect to separate the load-carrying parts of the machine from parts which are responsible for the precise positioning of the work piece; we hope to carry the principle embodied in the precision jig borer to its logical conclusion on a milling machine."

Dr. Bowden says that the work is sponsored by the National Research Development Corporation and has the support of machine tool makers and of Ferranti's and other leading electronic engineers. At least two other British firms have built electronic positioning devices for machine tools and have sold control mechanisms to American manufacturers.

* * *

The Royal Fine Art Commission are not, as might be supposed, concerned only with architecture, sculpture and painting; one of their main objects is "to inquire into such questions of public amenity . . . as may be referred to them from time to time by any of our Departments of State." Thus the Commission is one of the several bodies who watch the activities of the Central Electricity Authority with an anxious eye. In their report for 1955 and 1956 the Commission express the view that the siting of the High Marnham power station will do irreparable harm to an attractive stretch of the Trent Valley. Apparently they were not consulted in advance by the C.E.A. which has now promised to do so on future occasions. On the subject of the new nuclear power stations the Commission considers the choice of sites at Bradwell, Essex, and Berkeley, Gloucestershire, as "particularly unfortunate." This, at least, is very much a matter of opinion. Most people I have met who know the places think that a handsome power station would improve them. The Commission have "accepted" the proposal to build a station at Inkley (? Hankley) Point, Somerset.

* * *

Commenting on the visit of three representatives of Euratom to nuclear research establishments in this country, the *Observer* says:—

> "The Government, the Atomic Energy Authority, and the industrial groups they met, were all helpful. This encouraging news should dispel the rumours that Britain was bent on exploiting her technical lead in atomic energy by taking a tough commercial attitude that might have forced the Euratom countries to look mainly to the United States for help."

This is very good but all the same a certain amount of commercial toughness will be necessary if this country is to recoup the enormous amounts which have been, and are being, devoted to nuclear research and development. And no doubt the United States will expect some return upon its also colossal expenditure.

* * *

A fairly recent development in horticulture is the use of artificial lighting to assist plant development and I was therefore surprised to read in the *Yorkshire Post* recently, under the heading of "Suffering Chrysanthemums," a complaint that the dusk-to-dawn brilliance of the mercury vapour street lamps had spoiled a Barnsley inhabitant's chances of becoming a champion chrysanthemum grower. It seems that with these flowers lighting must be used judiciously and that short days are necessary for bud formation. Professional growers, in fact, use artificial lighting to retard their blooms in order to obtain higher prices; in this particular case it was too effective.

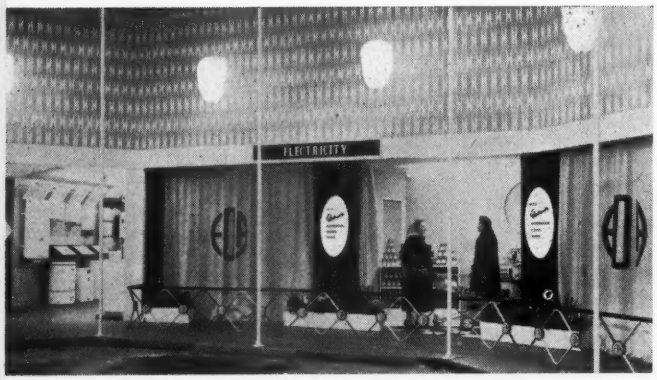
* * *

The name of Arthur Wright is still well remembered among electricity supply engineers if only by reason of his maximum demand tariff and meter. It was over seventy years ago that Wright commenced his activities at Brighton and his progress was reported on in the *Electrical Review* of 11th March, 1887, which said:—

> "The area of supply is at present limited only by the extent of the demand; that is to say, there is sufficient plant at the central station to permit of a much larger supply of current than is at present called for, although the managing director, Mr. Arthur Wright, is not without hopes that he will soon succeed in persuading a greater number of the inhabitants that it is to their interest to adopt the newer and purer light. The engine supplying motive power is capable of running 3,000 incandescent lights, but it is calculated that there would be no difficulty in lighting houses wired for 6,000 lamps, as it rarely or never happens that more than half the lights are in use at one time. A second engine and boiler are kept in reserve, and always in readiness, so that, in the event of the first engine breaking down, the lighting would not be interrupted."

Ideal Home Exhibition

Wide Range of Electrical Appliances Displayed



E.D.A. stand at the 1957 Ideal Home Exhibition. The photograph shows one of the three playlets, demonstrating how electricity brings automation to the home, being enacted

ELECTRICAL appliances and equipment are again well to the fore at this year's *Daily Mail* Ideal Home Exhibition which is being held at Olympia, London, until the end of this month. Automation in the home, through the medium of the automatic electric cooker and other time-controlled electrical appliances, is the theme of the British Electrical Development Association's exhibit. The story is conveyed by means of a series of three 3-minute playlets performed continuously during each day. The entertainment, though in a light vein, has a serious purpose and is supported by a mass display of domestic appliances including automatic cookers, washing machines, clothes dryers, ironers, dishwashers, refrigerators, vacuum cleaners, fires, clocks, kettles, etc.

Of special interest is a display devoted to automatic water heating which consists of four examples of particularly bad water heating schemes with, as a contrast, a series of electric water heaters in operation.

This year, for the first time, the *Daily Mail* house features under-floor heating.

Coinciding with the opening of the exhibition the English Electric Co., Ltd., announces reduced prices for its latest washing machines, models 4004 and 4005. In addition to the standard cream and white finishes for these machines, table tops in three pastel shades are now available. For the first time the company is showing a complete range of its appliances in a choice of five colours. So that decorations may be matched, colour is only applied to easily replaced surfaces, such as washing machine tops, refrigerator doors, cooker hobs, etc.

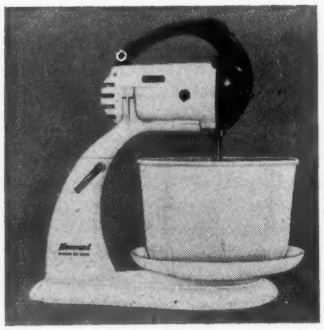
A new model of the G.E.C. "Quality" cooker has a full-view glass inner door to the oven, in addition to a roomy storage drawer now fitted into the base. The company's modified 4 cu ft refrigerator has its unchippable plastic-on-steel interior framed in a new colour, carnival tint. Other points are a freezer with a door and a turn-around shelf. The new G.E.C. 2 gal 1·2 kW water heater is also on show. It is thermostatically controlled and has been designed to keep installation and maintenance costs to a minimum. One nut and bolt and two screws hold it to the wall.

A neat 1½ gal water heater, model A.Q./1½, has been introduced by Berry's Electric, Ltd., in addition to their 3-gal model. Completely automatic, it occupies a minimum of wall space and is available in white, cream, pastel blue or green. "Magicoal" fires on view range from a simple coal-effect fire, costing just over £11, to "period" grates at over £100. Electric central heating is represented by the "Raydair," a thermostatically-controlled radiator. Contemporary lighting fittings also form a large part of the Berry's display.

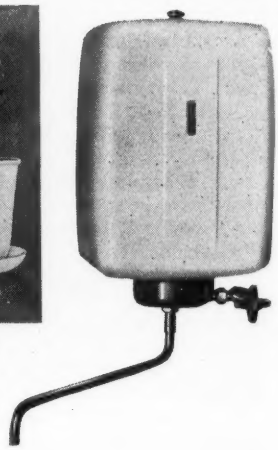
The "Creda Debonair," claimed to be Britain's first spin dryer, is demonstrated on Simplex Electric Co.'s stand, where a seated audience can watch the complete process of clothes drying. A load of wet washing (equivalent to 6 lb dry weight) is put into the dryer, spun for four minutes, then removed and ironed immediately. The whole of the stand is devoted to the demonstration, the "Creda Crusader" water heater being used. Illuminated transparencies depict other domestic appliances of the company.

Chilton Electric Products, Ltd., demonstrate their "Chilton" spin dryer dealing with garments ranging from nylon stockings to fishermen's knitted jerseys. Other

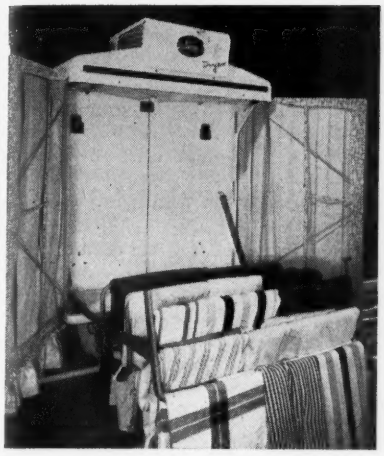
Hotpoint model H.50 5 cu ft refrigerator



Kenwood "Minor" de-luxe portable food mixer



Berry's Electric A.Q. water heater



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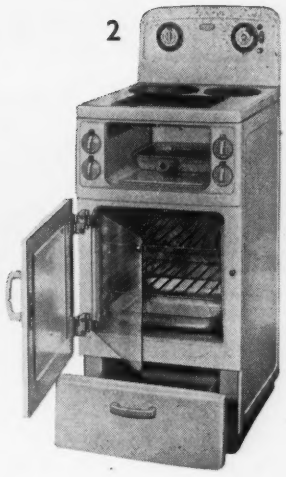

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1. Wilkins & Mitchell "Servis" clothes dryer and airer. 2. Latest version of the G.E.C. "Quality" cooker. 3. Electrolux B.9 triple brush floor polisher fitted with the new polish distributor

products exhibited by this company are home hair clippers, a range of dry shavers and the new "Accu-Lux" torch which needs no batteries, being charged overnight direct from the mains.

Visitors to the Electrolux stand will have the opportunity of inspecting the new polish distribution accessory designed for fitting to the B.9 triple-brush floor polisher. It is fitted to the base of the polisher and is operated by a chain which fits to the handle. The container holds about ¾ pint of liquid polish. Also on the stand is the new model 62 vacuum cleaner.

Included among a wide range of vacuum cleaners shown and demonstrated on the stand of Hoover, Ltd., is the "Constellation" cleaner of spherical design. Other exhibits include washing machines—both the Mk. II and III are now available with a heater—and steam-or-dry irons.

The Kenwood Mfg. Co., Ltd., is showing two new appliances, a de-luxe portable "Minor" electric food mixer (A.310) that should satisfy the demand for a mixer sturdy enough to tackle the harder jobs yet sufficiently light to be used as a portable hand mixer, and a new fan-heater, the "Activair." The special attraction of the latter is its "air-fresher" cell which circulates cold air as well as warm, making it ideal for summer or winter use.

The latest addition to the "Servis" range of home laundry equipment on the Wilkins & Mitchell stand is an electric clothes dryer and airer. As can be seen from the accompanying illustration, it is designed for wall mounting; it is capable of accommodating the equivalent of 20 to 30ft of clothes line washing. The fan and heater are fitted at the top of the cabinet. A full range of washing machines is demonstrated, special emphasis being placed on the two-tone "Gaytone" coloured models. The latest model in the small "S" class now includes an automatic timer which can be pre-set to switch the machine off at the end of the washing time.

The Hotpoint Electric Appliance Co., Ltd., has two new models in its 1957 range of "Coldrator" refrigerators, the CT.36 (3·6 cu ft) and the CT.50 (5 cu ft). Both are table-top models and are available with white, green, red, blue or cream working surfaces. The new Hotpoint H.50 (5 cu ft) refrigerator is supplied with an easily cleaned armoured plate-glass top. It also incorporates the "Buttador" thermostatically-controlled butter conditioner.

Continuous demonstrations of the "Dishmaster" dish-washing machine, claimed to be able to wash, rinse and dry all the dishes of a main meal within four minutes, are given by Dishmaster (London), Ltd. This company is also showing the "Wastemaster," an electrically-operated garbage disposal unit which fits into the waste pipe from the kitchen sink.

The Dishlex Division of Scotts Engineering (Newport), Ltd., have on view their new automatic commercial dish-washer, capable of handling 450 pieces of china, glass and cutlery in an hour. The fact that the machine also sterilises the articles washed makes it particularly suitable for hospital use.

In addition to their range of oil-filled electric heaters, towel rails, airing-cupboard heaters, etc., Dimplex, Ltd., are this year displaying new convector/radiant heaters and an infra-red heater. The convector has the latest slim-line styling, two-stage heat control (750 and 1,250 W) and is provided with two neon indicator lights. There is also a convector/radiant type with an additional 1 kW spiral-wound element controlled by a switch under the handle. The infra-red heater is fitted with a 750 W Inconel element and can be vertically or horizontally mounted on to walls or ceiling by conduit or chain suspension. Its narrow beam chromium-plated reflector, which directs a warm beam through an arc of 180 deg, is 31½in in length and the overall height is 6in.

A wide selection of panel and column type oil-filled electric radiators is also shown by Hurseal, Ltd., whose display includes their latest airing cupboard heater.

A number of modifications have been made to the range of wash boilers exhibited by Burco, Ltd., in particular the 2 kW "Baby Burco," which is now fitted with a three-heat d.p. control switch.

The "Mixmaster Junior" portable electric food mixer with three-speed control demonstrated on the Sunbeam Electric stand is provided with two heaters and a wall bracket, for stowage when not in use. The mixer is finished in white, with black handle, and red control button.

In the building sundries section Black & Decker show a full range of powered tools for the home workshop, including saws, sanders, polishers, hedge trimmers, etc. The latest additions are a ¼in de-luxe drill and a ⅜in drill. Domestic portable electric tools and accessories for the home handyman are also shown by Wolf Electric Tools, Ltd., including attachments for shoe repairing.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. A. R. W. Low, P.C., C.B.E., D.S.O., T.D., M.P., the former Minister of State, Board of Trade, has been appointed a director of the General Electric Co., Ltd.

Mr. R. H. Price, A.M.C.T., M.I.E.E., A.M.Inst.F., has been appointed area chief engineer, No. 5 Area (Eastwood), East Midlands Division, National Coal Board, and takes up his new duties on 11th March. Mr. Price, who has been generation engineer (construction) in the Yorkshire Division of the Central Electricity Authority since 1952, received his technical education at the College of Technology, Manchester, and served his apprenticeship in electrical engineering, and as a special trainee in mechanical engineering with the Metropolitan-Vickers Electrical Co. He was on the staff of the General Engineering Department from 1934 to 1937. During the next seven years he served with the Barrow-in-Furness Corporation Electricity Department as technical assistant (construction), after which he was seconded for three years as assistant mechanical and electrical engineer, Air Ministry Works Directorate, London. In 1947 he went to Sheffield as deputy construction engineer, and on nationalisation of the electricity supply industry in 1948 became construction engineer (electrical) in the Yorkshire Division of the C.E.A.

Mr. R. H. Price

The components group of the Plessey Co., Ltd., announces the appointment of **Mr. F. C. Loughborough** as executive assistant (sales) to the group director, Mr. John A. Clark. Mr. Loughborough is well known in the radio industry and has held several commercial appointments with various divisions during his ten years' service. He was previously with the Brush Group.

Mr. J. Peter Ford, M.A., A.M.I.E.E., has been appointed to the board of Associated British Engineering, Ltd., as an executive director.

Mr. E. Cockroft, A.M.I.E.E., senior assistant engineer (operation and maintenance), Grimsby Sub-Area, Yorkshire Electricity Board, has been appointed sub-area engineer, Grimsby Sub-Area. He received his training under the late Mr. F. N. Rendell-Baker, who was at that time in charge of the Halifax undertaking, and served on the Halifax Corporation staff until 1945. After holding the position of mains engineer at West Bromwich and Barnsley, he went to Grimsby Sub-Area towards the end of 1948 as assistant engineer. He was in charge of the Sub-Area distribution design work for a number of years before taking over the supervision of operation and maintenance early in 1954. He took up his new appointment on 1st March.

Mr. Leslie Gamage presided at a luncheon at the Connaught Rooms, London, on Friday last at which tribute was paid to seventeen members of the head office staff of the General Electric Co., Ltd., who had retired on pension during the past year. Among them were three who had served over fifty years with the company.

Mr. J. R. Sylvester, who was until recently the assistant buyer in the Radio Department of William Whiteley, Ltd., has now been appointed manager of the Radio Service Department.

Mr. R. Brodie, who joined Square D, Ltd., last October, has been appointed area manager of the company at its new branch offices at 235, Bath Street, Glasgow, C.2 (telephone: Central 3260).

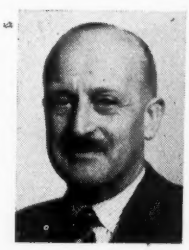
Mr. W. E. Cooper, who has been associated with Bakelite, Ltd., and one of its predecessors for thirty-five years, has resigned from the board because of ill-health. **Mr. A. Lloyd,** at present production controller, has been appointed a director to fill the casual vacancy caused by Mr. Cooper's resignation. Mr. Lloyd will be known as production director.

Mr. E. H. Beech has been appointed superintendent of the foundries and pattern shop of the Metropolitan-Vickers Electrical Co., Ltd., in succession to **Mr. A. Phillips,** who remains with the company in an advisory capacity. Mr. Beech joined the company as an apprentice in 1923, and has been continuously engaged on foundry work. He is a past chairman of the M-V Foremen's Association, and was appointed assistant superintendent of the foundries in 1950. He is this year's president of the Institute of British Foundrymen (Lancashire Branch), having been an active member of the committee for many years.

Mr. E. H. Beech

Mr. A. E. Knight was the guest of the directors of Heatrae, Ltd., at a luncheon at the Caister Hall Hotel, Norwich, on 28th February on the occasion of his retirement, under the company's pension scheme, after thirty years' service.

The authors of the article on "Butyl Rubber for Dielectrics" (page 421) are on the staff of W. T. Henley's Telegraph Works Co., Ltd. **Mr. B. B. Evans,** B.Sc., F.R.I.C., F.I.R.I., who has been the chief chemist of Henley's Research Laboratories since 1944, obtained a B.Sc. degree with first class honours at Birmingham in 1921 and in the same year was elected to associateship of the Royal Institute of Chemistry. After a year's post-graduate work at the Rubber School, Northern Polytechnic (now the National College of Rubber Technology) he joined Henley's Research Laboratories as a rubber chemist. During the war Mr. Evans served on numerous committees connected with the conservation of rubber and the introduction of synthetic rubber.



Mr. B. B. Evans

Mr. J. B. Dykes

Mr. J. B. Dykes, B.Sc., A.I.R.I., gained his degree at St. Andrews in 1947 and joined Henley's Research Laboratories in 1951 after preliminary experience with the Dunlop Rubber Co. and is engaged continuously on research and development connected with the application of natural and synthetic rubbers to cables.

Mr. Angus Murray, B.Sc., A.M.I.Mech.E., has been appointed managing director of the Expert Tool group of companies.

The London Area golf meeting of the **Electrical Industries National Golf Championship** will be held at St. George's Hill Golf Club, Weybridge, on 4th July. The competition is open to all in the electrical industry and golf cards can be obtained from Mr.

L. H. Welch, secretary of the London Committee, c/o London Electricity Board, 60, St. Martin's Lane, W.C.2.

The sixth annual dinner of the **Johnson & Phillips Sports Club** was held in the works canteen on 22nd February. Mr. W. Glass, M.I.Mech.E., managing director, proposed the toast of the Club, and the chairman of the Club, Mr. W. J. Lock, replied. Mr. S. Wood proposed the health of the guests, including Mr. Leslie Ames, and Mr. H. New, secretary of the L.B.H. Referees' Association, responded for the guests. The dinner was followed by the presentation of cups and medals won during the preceding year and included a new trophy (a gift of Mr. Glass) for yearly competition by the bowls section. This cup was presented to the first winner, Mr. E. Amos, by Mr. Glass. The evening concluded with an entertainment.

Mr. W. Glass presenting his trophy to Mr. E. Amos at the J. & P. Sports Club dinner

Mr. K. L. Stretch, M.A.(Cantab.), LL.B.(Lond.), A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., who writes in this issue on "Nuclear Power Station Operation" (page 415), is with the United Kingdom Atomic Energy Authority, Industrial Group, as works manager at Calder Hall.

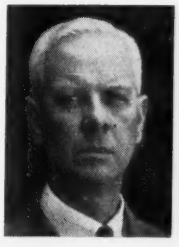
Mr. K. L. Stretch

He was educated at Crosby and at King's College, Cambridge, and in 1939 joined Mather & Platt, Ltd. After six years in the Royal Artillery and Royal Electrical and Mechanical Engineers he returned to Mather & Platt as research engineer. In 1948 Mr. Stretch joined Imperial Chemical Industries, Ltd., as instrument manager. A year later he was appointed deputy works engineer of the General Chemicals Division and in 1951 mechanical design engineer of the Salt Division, where he remained until taking up his present position in 1954.

OBITUARY

Mr. Charles James Simon Murton, managing director of John E. Schofield (1946), Ltd., Dewsbury, died on 21st February in Huddersfield at the age of sixty. Mr. Murton went to Huddersfield in 1919 and organised the electricity supply for the old Slaithwaite Council in 1924, becoming electrical engineer to the Slaithwaite Council and later to Colne Valley Council. He had acted as consulting engineer for a number of undertakings, and he was Commandant of Huddersfield's Special Constabulary.

Mr. F. H. Clough.—The death occurred on 25th February in his seventy-ninth year of Mr. Frederic Horton Clough, C.B.E., M.I.C.E., M.I.E.E., who, until his retirement in 1947, was for many years assistant chief engineer of the British Thomson-Houston Co., Ltd., Rugby.



The late Mr. F. H. Clough

Mr. Clough was born in Melbourne, Australia. After being educated at Geelong Grammar School, he became an apprentice in 1896 with the Austral Otis Engineering Co., Melbourne. Two years later he joined Siemens Brothers of Woolwich. In 1901 he went to Germany and was engaged on experimental testing with Siemens & Halske, Berlin. In the following year Mr. Clough joined the B.T.H. Co., at Rugby in the Design Department, and later became responsible for the design of turbo-alternators. For a period during the 1914-18 war he was technical adviser to the Director of Torpedo and Mining at the Admiralty, and for his services was awarded the C.B.E. Mr. Clough became assistant chief engineer with the B.T.H. Co. in 1919.

Mr. Clough was a past-chairman of the Midland Centre of the I.E.E. and served on the Institution Council. He was also a member of many Committees of the I.E.E., the B.E.A.M.A. and the B.S.I.

Mr. W. T. Baldwin.—The death occurred recently of Mr. William Townley Baldwin, chairman of Baldwin & Francis, Ltd., electrical engineers, Sheffield.

WILL

Mr. M. C. Timms, M.I.E.E., formerly manager of the cable factory of Submarine Cables, Ltd., who died on 23rd December, intestate, left £1,045 gross (£991 net).

A.E.M.T. Convention

The annual Convention of the Association of Electrical Machinery Trades will be held from 27th to 30th April at the Queen's Hotel, Eastbourne. Owing to fuel rationing this year's Convention will be on an informal basis and no special functions have been arranged. On the first evening there will be an informal dinner and dance. Sunday will be a free day, and on Monday morning the Council meeting will be held. In the afternoon members will visit the works of Allen West & Co., Ltd., Brighton, and afterwards the company will entertain members and their ladies to tea at the Old Ship Hotel, Brighton. There will be a "get together" in the evening. The Convention will close on Tuesday morning with a discussion on matters of interest to members.

Equipment for Spain

The English Electric Co., Ltd., has received a further order from the Spanish National Railways for fifteen 3,600 h.p. 3,000 V d.c. electric locomotives. These will be identical to the sixty English Electric locomotives now in operation in the north of Spain. The Vulcan Foundry, Ltd., will build the mechanical parts. The locomotives, each weighing 118 tons, are designed for a track gauge of 5ft 6in.

The English Electric Co. has also received a further order for electrical equipment for the Aviles Steelworks in the north of Spain. The company has already executed orders amounting in all to about £1,500,000 for mill drives, distribution and rectifier equipment for these works. The value of the new locomotive and steel mill electrical equipment orders is approximately £1,800,000.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £243 10s 0d
Fire Refined 99·7%	ton £242 0s 0d
Fire Refined 99·50%	ton £241 0s 0d
COPPER Tubes ..	lb 2s 4½d
Sheet	ton —
H.C. wire and strip ..	ton £292 15s 0d
LEAD, English ..	ton £113 5s 0d
Foreign	ton £112 0s 0d
MERCURY	flask £84 15s 0d
TIN, block (English) ..	ton £773 0s 0d
ZINC, G.O.B. Foreign	ton £97 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 11½d
Sheet	ton —
Wire	lb 2s 8½d
PHOSPHOR BRONZE Wire	lb 4s 0½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26½d—26¾d

A New Electron Microscope

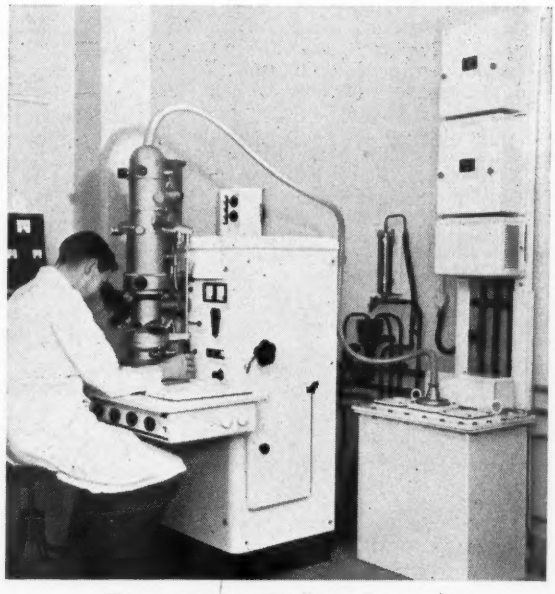
FUNDAMENTAL studies of the structural changes in alloy steels will receive a further impetus as the result of the installation of a Siemens II electron microscope at the central research and development department of the United Steel Companies, Ltd. With this new equipment it will be possible to obtain magnifications of up to 100,000 times.

The principle of operation of the microscope is that a high voltage beam of electrons is discharged from a source unit through the specimen, focused in a series of magnetic lenses and finally projected on to a fluorescent screen to produce a visible image. The amount of magnification is controlled by the strength of the magnetic field in the lenses and it is possible to obtain magnifications in stages from 300 to 30,000 times. Photographic enlargement can then increase this magnification up to 100,000 times.

It is not possible to pass an electron beam through a thick metal specimen and it is therefore necessary to use a replica. Very great progress has been made in replica techniques in the last year or two which has considerably extended the use of the electron microscope in metallography. The original technique used a thin film of plastic which could be stripped from the etched metal surface and examined in the microscope. These plastic replicas have the disadvantage that they tend to polymerise in the electron beam which introduces a structure in the plastic film itself and destroys the finer details of the replica. Because of this feature the maximum magnification which can be used with a plastic replica is about 10,000 times.

If carbon is used as a replica material, however, this disadvantage is overcome. Carbon replicas are extremely strong and no change in structure is produced by the electron beam. Consequently, magnifications up to the full limit of the microscope can be used. Carbon replicas can be made either by depositing a layer of carbon on a plastic replica and then dissolving the plastic film away or, alternatively, by depositing the carbon directly on to the metal surface.

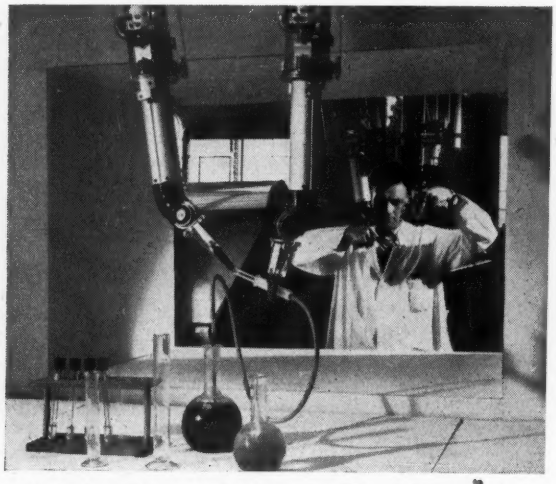
It is likely that the electron microscope will have two important applications in the examination of metal structures. The first of these is where the magnification required is just outside the range of the optical microscope, i.e. up to 5,000 times. This degree of magnification will be extremely useful for the examination of fine metallographic structures such as martensite and bainite. The other main application will use the highest magnifications to examine extremely small particles such as carbides at the beginning of a precipitation process. These dispersions of fine carbide particles are very important in controlling metallurgical properties such as creep strength and it is not possible to examine them by any other means. The components of the electron microscope were produced by the following manufacturers: Microscope, Siemens & Halske; electrical equipment, Siemens-Schuckert; transformer, Siemens Reiniger Werke.



Electron microscope for alloy steels research

Master Slave Manipulators

EQUIPMENT which has been designed to a specification of the Atomic Energy Research Establishment at Harwell and makes possible the remote control of experiments and operations on dangerous radioactive materials is now being made by Savage & Parsons, Ltd., at their Watford, Hertfordshire, factory.



Manipulators being tested at the works of Savage & Parsons, Ltd.

Previously the only equipment available was of American design and manufacture and cost approximately £300 more than the British model, the first of which was supplied to Harwell in February this year. Three-dimensional television developed by Marconi's Wireless Telegraph Co., Ltd., may be used in conjunction with the manipulators in order to provide close-up views of experiments and also to facilitate operation and experiments in corners of the "hot" cell where direct vision is not possible.

The type of manipulator illustrated is capable of operating through a biological shield 6ft thick and is controlled by clips attached to the operator's fingers. The movements of the fingers are transmitted through a system of extension rods terminating in a mechanical "hand," which reproduces the hand and finger movements of the operator. The material used is mainly of light alloy and stainless steel and consists of over 500 moving parts, each part being carefully counterbalanced to reduce frictional loss.

Development work is now being carried out to provide equipments which will be capable of remote manipulation up to distances of half a mile. Marconi's and Savage & Parsons have agreed to co-operate in the supply of 3-D television equipment and master slave manipulators to atomic energy establishments throughout the world.

Nuclear Power Programme

MINISTER OF POWER'S STATEMENT

IN the White Paper, " A Programme of Nuclear Power " (Cmd. 9389) published in February, 1955, the Government envisaged the erection of twelve nuclear power stations with a total capacity of between 1,500 and 2,000 MW in the ensuing ten-year period. Since then it has been made clear in statements by Ministers and spokesmen of the power authorities that this programme would have to be considerably expanded.

Already contracts have been placed for three stations; work on two of them has already begun and the third will be proceeded with very shortly. The 1955 programme provided for the commencement of construction of only two in mid-1957, with the next two following in 1958-59. Prospective capacities are also much greater than those set out in the White Paper which specified stations of from 100 to 200 MW. The stations already ordered will, it is claimed, have ratings ranging from 275 to 360 MW.

For some months past it has been expected that the Government would supplement its White Paper with particulars of the programme revision which was contemplated. On Tuesday last the long-awaited statement was made simultaneously by Lord Mills, Minister of Power, in the House of Lords, and by Mr. Reginald Maudling, Paymaster General, in the House of Commons.

In this it was stated that since some £250 million was spent annually on the importation of fuel, chiefly oil, and this burden on our balance of payments would continue to grow, the importance of developing nuclear power as a source of energy could not be in doubt. The task had therefore been to consider the extent to which the 1955 programme could be accelerated in view of technical advances within the last two years.

It was the considered opinion of the Government's advisers that in the light of present knowledge the electricity authorities could reasonably aim at having at least 5,000 MW of nuclear capacity in operation by the end of 1965, and that if technological development continued to be favourable and the necessary physical and financial resources could be found, a figure of 6,000 MW could be achieved by that date.

Threefold Increase in Planned Capacity

The Government had accordingly decided, with the full agreement of the electricity authorities and the Atomic Energy Authority, to adopt as the basis for present planning a range of 5,000-6,000 MW of nuclear capacity in operation by the end of 1965. This meant that the supply of raw materials for nuclear generation, the acquisition of sites and the planning of the transmission network would be on a scale sufficient to bring 6,000 MW of nuclear capacity into operation by the end of 1965. The actual amount of nuclear capacity to be installed by that date would be subject to technical experience and development as planning progressed, including the trend of capital costs, and to the availability of physical and financial resources.

The Government of Northern Ireland also intended to bring into commission a 150 MW nuclear station in 1963 or 1964.

The execution of this nuclear programme would make a major contribution to our energy resources; a full year's operation of 6,000 MW generating capacity would save some 18 million tons of coal. But it would also mean a large increase in the annual investment programme of the electricity authorities during the early 1960's and this would represent a very heavy burden on the nation's capital resources during a period when those resources were likely in any event to be seriously strained.

Approval Procedure to be Speeded Up

The programme would involve the erection of new power stations and of overhead transmission lines in parts of the country which had not hitherto felt the impact of the nation's requirements for electricity. This was unfortunately inevitable because nuclear stations raised special siting problems. The Government and the electricity authorities were determined to carry through the programme with the least possible interference with the amenities of the countryside or with the rights of individuals. They believed this could be done and at the same time that some provision could be made for that acceleration of the present procedure which was essential if the programme was not to be seriously delayed. The Paymaster General would accordingly be tabling amendments to existing legislation for inclusion in the Electricity Bill.

The statement added that nothing said about the prospects of the nuclear power programme in any way affected the importance of the coal industry. Coal would remain the basis of our economy and the need to exploit to the full our national coal resources remained as urgent as ever.

Reducing Dependence on Imported Fuel

Lord Mills presided at a Press conference on Tuesday afternoon. He was accompanied by Mr. Maudling, Sir Christopher Hinton, Sir John Maud, Lord Citrine, Sir Henry Self, Sir Josiah Eccles and others.

He said that when the first nuclear power programme was announced in the White Paper of February, 1955, it was thought that 1,500 to 2,000 MW of nuclear generating capacity could be installed by 1965. But a great advance had been made since then, an advance in which the Atomic Energy Authority, the electricity authorities and the manufacturing industries had all played a vital part. The Government was now able to announce a considerable expansion of the original programme. There were very good reasons for this decision. The demand for electricity was growing year by year; it had increased by some two-thirds in the last seven years. Every year we were becoming more dependent upon imported fuel, chiefly oil, and this constituted a growing burden on our balance of payments. It also laid us open to the perils, now being experienced, of being heavily dependent upon a fuel which had to be imported.

Our need for more and more power, which could not be matched by our natural resources, had provided us with the urge to lead the world in the development of nuclear power, and the skill of our scientists and engineers had made possible the much more ambitious programme than was envisaged two years ago. But ambitious as the

programme was, it could not by itself meet the whole of the demand for additional power with which we would be faced if the mechanisation of our production processes was to proceed and thus enable us to compete in an increasingly competitive world and to take our share in supplying the growing needs of the under-developed areas of the world.

Answering questions, Lord Mills said that the plan was a part of the general programme for power plant; £235 million a year was spent now; it would go up to £400 million a year by 1965.

Part of the funds would come out of the resources of the electricity supply authorities; the balance would come from Government resources. There would probably not be more than 19 stations. He could not say whether there would be any more in Scotland but there would probably be one in Wales and another in Northern Ireland. This could be considered a part of the normal power programme. It was the intention to get experience before stations were constructed near built-up areas.

Capital and Operating Costs

Lord Citrine said that nuclear stations needed large quantities of water and there was no alternative to sites on the coast or river estuaries. They also wanted to avoid putting stations up in the coal areas. The £300 million given in the White Paper for twelve stations would rise to about £919 million in the new programme. The excess cost of providing 6,000 MW of nuclear plant instead of conventional plant would be £750 million. Although by 1965 the capacity of the nuclear stations would be 15 per cent of the total plant capacity their output would be about 25 per cent of the total as they would be run as base-load stations.

Lord Mills said that operating costs would be ultimately much lower although the first three stations would generate at a slightly higher cost than conventional plant. The Northern Ireland station was extra to the 19 stations mentioned.

The Ministry of Power, said Lord Mills, was endeavouring to shorten the procedure for obtaining site approval. The programme had been carefully phased to permit manufacturers to cater for export trade. Our energy requirements were growing so quickly that it would be a long time before nuclear stations could meet them all.

Sir Josiah Eccles said that the £300 million mentioned in the White Paper included processing plant and other things. The 6,000 MW of plant would cost £742 million and the initial fuel charge £177 million, a total of £919 million. The kW cost was actually lower than for the Bradwell and Berkeley plants—£124 per kW for plant and £9 per kW for fuel.

Manufacturing Capacity Adequate

Lord Mills said that the capacity of the engineering firms would be sufficient to meet the programme and the necessary supplies of steel were being planned. They expected also a considerable volume of exports, which would be supplied. The export demand would grow very gradually; if, however, orders were received earlier than was anticipated they would not be refused.

Sir Edwin Plowden said that by 1964 or 1965 plutonium would be available from these stations for the supply of enriched fuel for more advanced types. The sale of plutonium from the stations would be the subject of a commercial arrangement with the C.E.A. The price would be fixed by the A.E.A. having regard to the American price.

Referring to the conventional plant programme, Lord Citrine said that this was not standing still; indeed, 550 MW sets were envisaged. Some 7,000 or 8,000 MW of conventional plant would be built parallel with the nuclear stations. As base-load stations nuclear plant had its limitations. They might eventually prove more flexible.

NUCLEAR POWER IN EUROPE

A FOUR-DAY visit was made to this country last week by a committee appointed by the Governments of Belgium, France, the Federal Republic of Germany, Italy, Luxembourg and the Netherlands, which are this month to sign a treaty instituting a European Atomic Energy Community (Euratom). The committee, composed of Monsieur Louis Armand (France), Herr Franz Etzel (Germany) and Professor Francesco Giordani (Italy), called on Lord Salisbury, the Lord President of the Council, and Lord Mills, the Minister of Power, and has held discussions with the chairman, members and officials of the United Kingdom Atomic Energy Authority and of the Central Electricity Authority. The committee also spent a day at Calder Hall and held discussions with representatives of the industries concerned with the United Kingdom Atomic Energy projects.

The committee's task is to determine the extent to which atomic power can meet Europe's growing energy needs. The availability and cost of energy has become a limiting factor on the growth of Europe's economic strength and welfare. The committee's review of the needs and possibilities has led it to adopt as an objective the stabilisation of coal and oil imports early in the 1960s. To meet this target would require that nuclear power plants with a total generating capacity of 15,000,000 kW should be installed within the next ten years.

The U.K.A.E.A. and the Euratom committee have held discussions concerning the contribution which the Calder Hall type of reactor could make to the realisation of this target and the assistance which the United Kingdom could give to the execution of such a programme. The U.K.A.E.A. declared its readiness to facilitate contacts between the United Kingdom firms and firms within the Euratom countries interested in the building of nuclear reactors. The Authority also declared its willingness to give such assistance as lies in its power towards the training of scientists and engineers. Places could be provided in the Reactor School at Harwell and later on at the Reactor Operation School at Calder Hall.

RHEOSTATS

THE British Standard dealing with field rheostats and rheostats for other purposes published eighteen years ago has just been revised and extended. The new publication, B.S. 280 : 1957, takes into account modern engineering practice, particularly with regard to new types of insulating materials and their classification. Three classes of rheostats have been specified in relation to their mechanical duty. They are: Class 1, Class 2, and Class 3, which have duty ratings of 2, 40 and 600 operations per hour respectively.

Permitted limits of temperature rise have been related to modern insulating materials as classified in B.S. 2757, "Classification of Insulating Materials for Electrical Machinery and Apparatus." The temperature limits are those long established as satisfactory in this and other countries. Other changes in the specification include a reclassification of the types of enclosures and the introduction of a new section on service conditions. In addition, the routine tests have been amended and type tests have been specified.

There are three additional appendices to the Standard. They deal with temperature measurement, clearances and creepages, and requirements of H.M. Forces for normal applications. The Standard was prepared under the authority of the B.S.I. Electrical Industry Standards Committee and copies may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 5s.

Commonwealth Standards

Further Discussions and Decisions at New Delhi

By a Special Correspondent

IN last week's *Electrical Review* the discussions and decisions on various aspects of cable standardisation at the recent New Delhi Conference of representatives of the standards organisations of Commonwealth countries were reported. This concluding instalment of the report covers the proceedings relating to safety requirements for domestic electrical appliances, the electrical equipment of machine tools and applications of steel.

Domestic Electrical Appliances

The discussions on safety requirements for domestic electrical appliances were held under the chairmanship of Mr. W. I. Stewart, chief technical officer of the Standards Association of Australia. This was appropriate, since the initiative for Commonwealth discussions on this subject came from the S.A.A. who, in 1951, drew attention to the fact that many domestic electrical appliances imported into Australia from the United Kingdom failed to a greater or lesser degree to comply with the requirements of the approvals authorities in Australia. The 1951 Conference therefore asked the British Standards Institution and the S.A.A. to put their heads together and draw up a statement as a basis for discussion in a wider circle at a future Conference. In implementation of this request the B.S.I. made a detailed comparison of the differences between the general safety requirements for electrical appliances as given in B.S. 816 and the corresponding Australian Standard C.100. On the basis of this comparison a model specification was jointly agreed by the B.S.I. and the S.A.A. to serve as a basis for discussion in Delhi.

The United Kingdom delegation consisted of Messrs. O. W. Humphreys, C.B.E. (director of research, G.E.C., and vice-chairman of the Conference), J. I. Bernard (E.D.A.), L. Gosland (E.R.A.), A. Tucker (Morphy-Richards) and J. F. Stanley (B.S.I.).

British and Australian Differences

Many of the differences between the British and Australian standards arose because in Australia the standards have a legal status and are used as approvals specifications. This affects the phraseology and, more important, results in the standards being based on the minimum acceptable requirements. The British Standards, on the other hand, have no legal status and, although they are used for the purposes of certification on a voluntary basis, do not necessarily cover the bare minimum requirements. Other differences are due to different operating conditions. The higher ambient temperatures and humidities in tropical regions, the possibility of dust accumulations and similar factors, impose special safety requirements.

The Conference took the view that complete identity in safety requirements throughout the Commonwealth, though desirable in principle, was impracticable, but every effort should be made to narrow down the differences as far as practicable.

An example of the slightly different approach to safety standards in the United Kingdom and Australia was revealed at an early stage in the discussions at the Conference. The British Standards for portable domestic appliances require that if a switch is incorporated in the appliance it must be double pole, except in cases where the appliance will be so connected to the supply as to ensure that the switch is in the live conductor, e.g. by means of a polarised (three-pin) plug. In practice the manufacturer has no control over the method of connection to the socket-outlet, with the result that the B.S. requirement is virtually that all switches should be double pole. In Australia double-pole switches are called for only for those portable appliances in which there is a definite risk of contact with live parts or for appliances likely to be used under hazardous conditions.

The need for a standard for dust-tight enclosures was raised by the Indian delegation, and it was agreed that this subject was too specialised to enable it to be dealt with in a statement on general requirements. It was reported that the B.S.I. was engaged in the drafting of suitable tests for dust-tight and dust-proof enclosures, and the application of these tests to specific types of equipment would be a matter for consideration when drawing up specifications for such equipment, these specifications being supplementary to the "general requirements" specification.

"Double Insulation"

The fairly new concept of "double insulation" as applied to domestic appliances was fully debated. This principle of design, which obviates the need for the earthing of appliances having exposed metal, is strongly favoured in Australia where earthing conditions are often poor. It was therefore gratifying to the United Kingdom delegation to learn that the Standards Association of Australia enthusiastically welcomed the publication by the B.S.I. of B.S. 2754, "Memorandum on the Design of Electrical Apparatus having Double Insulation," which they considered to be an admirable exposition of the principles involved. In particular, they commended the use of the terms "functional insulation" and "protective insulation" to denote the two separate layers.

The use, in certain circumstances, of single insulation as a means of securing exemption from earthing was another important point raised. Single insulation used in this way is referred to in the specifications of the International Commission on Rules for the Approval of Electrical Equipment (the C.E.E.) as "reinforced insulation," and the question of its recognition in British Standards is at present giving rise to a certain amount of controversy in the United Kingdom. The Australian delegation at the Conference stated that appliances having "reinforced insulation" (a term not so far used in Australia) had been approved and were regarded as perfectly satisfactory. They appreciated, however, the difficulty of drafting satisfactory safeguards for inclusion in specifications, since the acceptability of single insulation in lieu of double insulation depended on the position and nature of the insulation and the possibility of its wear, heating, destruction or deterioration. It was, in other words, largely a matter to be decided at the discretion of the approvals authority.

The only requirement that could be specifically laid down in a specification was the test voltage, and in the Australian Standard this was given as 2,500 V applied

for one minute. The United Kingdom delegation pointed out that the test voltage for " reinforced insulation " under discussion by the B.S.I. was 3,500 V, the same as for double insulation. The Australian delegation agreed in principle that this was a step in the right direction and they undertook to ask the S.A.A. to consider whether they could adopt the B.S.I. proposal for the test voltage. They emphasised, however, that they would not wish to do anything that would cause rejection of equipment which had already been approved on the basis of the present S.A.A. test of 2,500 V.

A major cause of accidents with portable appliances is the connection of the earthing conductor to a live terminal, and stress was therefore laid on the importance of agreed marking of terminals and the permanence of the marking, particularly of the earth terminal. It was considered that the stamping of the letter " E " or the word " Earth," or the international " earth " symbol would be more permanent than colouring, and was therefore to be preferred. The earth symbol, used extensively in Continental countries, was regarded as acceptable only as supplementary to other marking and not as a substitute. Green is universally used in Commonwealth countries as the colour for the earthing conductor of flexible cords and there appeared to be no possibility of coming into line in this respect with the Continental practice of using red. In view of this the United Kingdom has urged upon the C.E.E. the desirability of encouraging all manufacturers of portable appliances to attach a label or sleeve to the flexible cord in order to distinguish the earth core from the current-carrying cores.

Cord Anchorage

The British Standards require that the cord anchorage on appliances to which the flexible cord is permanently attached shall be designed so as to grip the cord as a whole, relieving the terminals of strain, the test for the effectiveness of the cord-grip being made with the conductors disconnected from the terminals. The Australian delegation agreed in principle that this was desirable, but they said that for many types of appliances the Australian rules permitted the " tortuous path " type of construction which depended for its effectiveness on some load being taken by the terminals. The test for effectiveness of anchorage was made with the conductors connected to the terminals, which accounted for the fact that the Australian test pulls on the cords were higher than the British. The Australian delegation said that the S.A.A. was so committed to the " tortuous path " type of cable entry that it might not be possible to rule it out in favour of the form of construction used in the United Kingdom.

The United Kingdom delegation submitted a table of air gaps and creepage distances, with a recommendation that they be adopted as minima. No such table exists in any other Commonwealth standard dealing with general requirements, though values are prescribed in some specifications for particular types of equipment. The United Kingdom proposals were commended for study by the standards organisations, with particular reference to their suitability as minima for tropical conditions.

One of the most useful fields for Commonwealth agreement was considered to be the question of limiting temperatures for insulating materials. Expressed in terms of temperature rise there would naturally be differences in the national standards according to the different reference ambient temperatures adopted, but it should be possible to reach agreement on the maximum temperatures to be permitted. This gave rise to a discussion on the relationship between limiting temperature and expected life, and reference was made to the temperature limits assigned to various classes of insulating materials in B.S. 2757. As this document had only recently been published, however, it was felt that its implications should be studied before attempting to specify temperature limits for materials as used for the insulation of domestic appliances. Views on this matter would be exchanged between the Commonwealth countries by correspondence.

An important difference in practice exists as regards the limiting temperature for vulcanised rubber insulation on internal wiring and on flexible cords. The United Kingdom delegation proposed a limit of 60 deg C, with the proviso that this could be raised to 75 deg C for appliances such as electric irons where the flexible cord is not expected to have an indefinite life, and may be further increased if insulating beads or sleeves are fitted over the individual cores in such a way that the rubber is not relied upon to prevent short circuiting. The Australian limit for rubber cords is 100 deg C, irrespective of the fitting of sleeves or beads.

For p.v.c.-insulated flexible cords the United Kingdom delegation proposed 60 deg C without qualification, but the Australian specification has recently been amended to allow a temperature of 100 deg C; this figure had been decided on as the result of tests of a duration of about 200 hours. The cords had not been subjected to any flexing during the tests.

A limiting temperature of 90 deg C for wood and other cellulosic materials was recommended, though this is higher than the present United Kingdom limit. There was general agreement on a limit of 75 deg C for polystyrene. A limit of 80 deg C at present worked to in the United Kingdom and Australia for cellulose acetate was thought to be on the low side.

On the question of marking, it was noted that the Australian practice was to base the rated (marked) wattage on the upper limit of marked voltage in those cases where the appliance was designed for use over a range of voltage. In the United Kingdom, however, it was the practice for the rated wattage to correspond to the mean of the marked voltage range. The United Kingdom delegation said they would recommend the B.S.I. to consider coming into line with Australian practice in this respect.

It will be seen from the above that the Conference was engaged mainly in a discussion of the differences between the Australian and United Kingdom standards. The other delegations were content to be mainly passive observers, since (with the exception of Canada) their standards for domestic appliances are not very far developed, and Anglo-Australian agreement would facilitate the development of standards in these countries.

Machine Tool Equipment

The discussions on the electrical equipment of machine tools were held under the chairmanship of Sir Stanley Rawson (vice-chairman, John Brown & Co., Ltd.), the other members of the United Kingdom delegation being Messrs. S. J. Harley (Coventry Gauge & Tool Co.), J. O. Knowles (vice-chairman, B.E.A.M.A.), W. L. Sims (Wadkin, Ltd.), and R. A. McKinstry (B.S.I.). The subject had been brought to the attention of the Commonwealth Conference by the B.S.I. and the recently published B.S. 2771, " Electrical Equipment of Machine Tools," was submitted as a basis for discussion.

Mr. Harley, leader of the United Kingdom delegation, explained that machine tool makers were sometimes faced with the handicap of having to provide electrical control equipment which incorporated special features to satisfy

the particular requirements of individual countries as embodied in their safety regulations and codes. A technical committee of the I.S.O. is working on the general overall dimensions of machine tools, but it has a large programme of work and at the present rate of progress will not be in a position to consider the electrical aspect for some years. It was for this reason that the United Kingdom recommended that, in the interests of Commonwealth trade, immediate consideration should be given to the co-ordination of specification requirements in Commonwealth countries for the electrical equipment of machine tools.

In presenting B.S. 2771 for the consideration of the Conference, the United Kingdom delegation said that in the preparation of the British Standard note had been taken of practice in the United States, with a view to minimising the differences between this standard and the American specifications issued by the National Machine Tool Builders' Association and by the Joint Industry Conference. Consideration had also been given to the Canadian Standard on the construction and test of electrically equipped machine tools, and the corresponding German specification.

B.S. 2771 was reviewed in detail by the Conference and a number of amendments, mainly of a minor nature, were suggested by the various delegations. One of the most important points on which differences of opinion were expressed related to the necessity for and function of the main isolating switch. The British Standard requires that this switch shall disconnect the whole of the electrical equipment of the machine tool from the supply and shall be capable of interrupting the maximum operating overload current of all the equipment which is connected to the circuit at any one time. It was pointed out that a manual switch operating in the control coil of the main circuit-breaker for the machine was a possible alternative and that for heavy currents the latter arrangement would be more economical. On the other hand, it was explained that in some countries the manually-operated switch operating directly in the main circuit was preferred, and in some cases was required by the national regulations.

It was recognised that no individual sub-circuit would normally be rated at more than 100 A, and the chances were that this sub-circuit would be supplying a number of motors, thus reducing the rating of individual isolating switches. There would be applications, however, where the full-load current of the motor supplying the machine tools would be more than 100 A. The Conference agreed that in such cases it was good practice to permit the use of an isolator interlocked with a circuit-breaking device so that the latter device tripped during the process of operating the isolator.

As at the other technical sessions, the special problems encountered in tropical countries were raised, and this in turn led to a discussion on the climate-proofing of machine tools. It was noted that the B.S.I. was at present drafting a code of practice and a specification for the climate-proofing of electrical equipment, and the subject was also being given attention in India. It was therefore arranged that an exchange of information should be maintained.

Technical Session on Steel

The decision to include the subject of steel on the agenda for the Delhi Conference was based on a proposal from the Indian Standards Institution, and it was therefore fitting that the chair was taken by Shri J. J. Ghandy (Tata Iron & Steel Co.). The vice-chairman was Mr. E. W. Senior, C.M.G. (commercial director, British Iron & Steel Federation). The United Kingdom delegation was a strong one, consisting of Messrs. H. M. Henderson (United Steel Companies), E. Ibbotson (Dorman, Long), H. Shierley-Smith, O.B.E. (Cleveland Bridge & Engineering Co.), G. B. Stewart, C.B.E. (Tubewrights, Ltd.), and R. A. McKinstry (B.S.I.).

The discussions differed from those at the other technical sessions in that there was no attempt to draw up recommendations in the form of model specifications, but there was a general pooling of experience in the use of standards for the *use* of steel. A paper on the subject had been prepared by the I.S.I., and the Indian delegation stressed the importance for their country of promoting the more efficient use of steel. This paper referred to the re-design of hot-rolled structural sections which was an important part of their steel economy programme. The Conference felt that the adoption of new standards in India was bound to be a hindrance to the co-ordination of standards for structural sections within the Commonwealth, but it was realised that the introduction of the metric system made it necessary for new sections to be designed, and the present was therefore the only time possible for making the change in view of the setting up of new mills and the expansion and renovations of existing mills.

A paper presented by the B.S.I. drew attention to the use of high-tensile steel and the advantages to be gained thereby in cases where reduction in weight was important, e.g. wagons, ships, bridges and jib booms. Another paper presented by the B.S.I. emphasised the sound and thorough methods adopted in the United Kingdom for formulating welding standards. The Indian delegation pointed out that there was still considerable scope in India for improving welding techniques and the work done by the B.S.I. was welcomed as a step towards Commonwealth collaboration. In the past most valuable guidance had been obtained from Sweden and the United States.

It was generally agreed that the discussions at the Conference, which had ranged over a wide field, had been most useful, and arrangements were made for full information regarding the development of standards for steel in the Commonwealth countries to be circulated as soon as possible.

Aggregate from Fuel Ash

SINCE their preliminary announcement in 1955 the Cementation Co., Ltd., have had erected at the Battersea power station, by Sinterlite, Ltd., two kilns to convert all pulverised fuel ash produced there into a nodular aggregate "Terlite" which has a weight of 48-55 lb/cu ft, depending on the size.

The use for the material will be widespread. Obvious outlets, where its light weight are invaluable, will be for roof and flooring members and screeds. High grade building blocks will no doubt absorb a substantial proportion of the material, while the development of lightweight concrete either cast *in situ* or as precast members of panels, can now be accelerated. Significant test results have been obtained from samples of the aggregate; for instance, blocks made from it have shown strengths of up to 3,000 lb/sq in with both moisture movement and drying shrinkage down to 0·025 per cent.

The Battersea plant is to be the basis for large scale research into the characteristics of the product of the Sinterlite process, particularly related to various types of pulverised-fuel ash. Subject to this research showing economic practicability it is hoped to locate similar plants at focal points throughout the country so that the demand for the material can be met wherever it arises.

Recent Lighting Installations

PLANNING FOR EFFICIENCY

THE illumination of industrial and commercial premises often calls for ingenuity in planning to satisfy architectural and working conditions. From the many examples of installations we have received, we illustrate on the facing page some noteworthy lighting schemes, in some of which these conditions have been met and successfully overcome, and we briefly detail below the types of equipment used.

At the Hudson Road, Leeds, premises of Montague Burton, Ltd., tailors, by using Crompton "Light Line" continuous trunking, many of the problems encountered when avoiding other services such as ventilating ducts, conveyors, and steam pipes, have been solved, without incurring the high initial cost of a conduit system. In one workroom there are 8,000ft of "Light Line" and 1,280 Crompton "Permawhite" reflector fittings. These replace the pre-war installation of filament lamps in diffusing reflectors and while providing more light give a saving of 65 kW, or 34 per cent, of the original load. The installation was carried out by the company's electrical engineering department, in co-operation with the lighting section of Crompton Parkinson, Ltd.

Spinning Mill Installation

For the new spinning mill in Belfast of the York Street Flax Spinning Co., Ltd., the entire lighting scheme was designed and supplied by Siemens Brothers & Co., Ltd., who also provided the cables bringing power into the mill, over 60 miles of wiring for the lighting alone being supplied. The installation was carried out by Messrs. James Crawford, of Belfast. The lighting is by tungsten filament lamps and in all over 1,900 lighting fittings have been installed and the positioning in every case has been planned in relation to the various processes and layout of machinery throughout the mill.

Two types of lighting fittings from their range have been used by George Forrest & Son, Ltd., in the hairdressing department of Kendal Milne's store at Manchester. These are used in combination with "Atlas" fluorescent lighting. Structural alterations revealed a higher ceiling level in one section of the salon, and this problem was overcome by fitting a false ceiling of V-shaped beams containing fluorescent tubes and giving an apparently continuous ceiling level. Existing recessed trough fittings were equipped with perforated "Perspex" diffusers to conform with the general design of the installation. To produce the correct blend of colour and light level "de luxe warm white" tubes were used. In the reception lounge Forrest modern glassware pendants are used and the perfume bar and reception desk are illuminated by specially designed satin brass reflector fittings. The lighting equipment was supplied through Magnum Distributors, Manchester.

In the machine shop, general assembly and fitting shop of the new factory of Zwicky, Ltd., filtration and pumping engineers, Slough, the Major Equipment Co., Ltd., has supplied 230 "Multi" 80 W twin fittings with reflectors, which provide efficient and even illumination.

A new exhibition hall was opened recently at the Longbridge, Birmingham, works of the Austin Motor Co., Ltd. The illumination of the showroom is operated from a control room, and it is possible to provide a variety of lighting combinations. Extending almost the 160ft length of the hall is a 27ft wide "Lumenated" ceiling consisting of three independently lit areas. The centre panel, which is 60ft long, is illuminated by an arrangement of 108 daylight fluorescent tubes and 48 each of red, blue and cyan tubes, the coloured tubes being arranged in groups of three. The two end ceiling panels are 30ft long, and each is illuminated by 63 daylight fluorescent tubes. Alternative lighting is provided by 5ft "new warm white" and "de luxe warm white" fluorescent tubes concealed behind the cornices of the main hall and in the flanking alcoves. The lighting equipment was supplied by the General Electric Co., Ltd., and installed by Walker Bros., Birmingham. The "Lumenated" ceiling was supplied by Lumenated Ceilings, Ltd.

The Westminster Bank, Lothbury, London, E.C.2, has 120 "Atlas" twin-tube fluorescent fittings installed in a 53ft by 44ft laylight. This laylight uses industrial type fittings with "Atlas" 3,500°K white tubes and provides the main lighting for the marble banking hall. To give supplementary illumination between the laylight and walls special bronze finish wall brackets and pendants were designed by George Forrest & Son, Ltd. Each pendant houses four 5ft fluorescent tubes, four 100 W tungsten lamps in the top and one 300 W lamp in the base, and the wall brackets each use two 5ft and two 4ft tubes. Illumination level varies from 45 lumens per sq ft beneath the laylight to 15 lumens on the counter enclosing the machine area. The electrical contractors for the laylight were John Hearson & Co., Ltd.

Foundry Scheme

The foundry of Platts (Barton), Ltd., has 200 twin lamp 8ft fluorescent fittings and 150 single lamp 8ft fittings made by the General Electric Co., Ltd. Mainly, the foundry produces castings of components for textile manufacturing machinery. The principal difficulty encountered by the G.E.C. engineers who planned the lighting scheme was caused by the large amount of overhead equipment necessary in the foundry. Twin "Osram" 125 W 8ft fluorescent tubes in trough reflectors have been mounted at two levels, the upper layout serving to light the conveyors and to provide general illumination, the fittings at the lower level being for local high intensity lighting. The core-benches, laboratories, control room and offices all have "Osram" 5ft fluorescent tubes in various types of fittings and tungsten fittings are used in the baths and changing rooms.

The new Singer Sewing Machine building in Bristol has been lit by "Ekco" lighting equipment. In the showroom there are three specially designed decorative pendant fluorescent fittings each containing six 4ft 40 W tubes. The secondary lighting is provided by concealed tubes within the cornices, and a pleasing effect has been obtained by means of illumination behind venetian blinds at the far end of the showroom. The illumination value is of the order of 20 lumens per sq ft.

"Mazda" fluorescent lighting has been installed in the municipal swimming bath at Leamington Spa, Warwickshire. Over the main pool twenty closed-end reflector fittings, each housing two 80 W fluorescent lamps, have been mounted on runners and can be drawn to the side galleries for easy maintenance. Auxiliary tungsten bulkhead fittings are also installed to light the galleries and dressing rooms. The contractor was L. W. Hodgkins, Leamington Spa.

1. *Leeds premises of Montague Burton, Ltd. (Crompton Parkinson, Ltd.).* 2. *Spinning mill of the York Street Flax Spinning Co., Ltd., Belfast (Siemens Brothers & Co., Ltd.).* 3. *Hairdressing saloon, Kendal Milne's store, Manchester (George Forrest & Son, Ltd.).* 4. *Factory of Zwicky, Ltd., Slough (Major Equipment Co., Ltd.).* 5. *Showroom of the Austin Motor Co., Ltd., Birmingham (Lumenated Ceilings, Ltd.).* 6. *Westminster Bank, Lothbury, London (Thorn Electrical Industries, Ltd.).* 7. *Foundry of Platts (Barton), Ltd. (General Electric Co., Ltd.).* 8. *Singer Sewing Machine showroom, Bristol (Ekco-Ensign, Ltd.).* 9. *Swimming bath, Leamington Spa (A.E.I. Lamp & Lighting Co., Ltd.)*

Engineering Education in the Soviet Union

Report of British Team Discussed

LAST September a team consisting of nine representatives of the leading branches of the engineering profession, headed by Professor E. Giffen, professor of civil and mechanical engineering at Queen Mary College, London, visited the Soviet Union to study the developments in higher technological education which have taken place in that country. Their report, which deals with the subject in great detail, has now been published and was discussed at a joint meeting of the Institutions of Civil, Mechanical and Electrical Engineers on 25th February.

In any country, it is pointed out, which is suffering from a shortage of engineers there are two main problems: finding enough suitable young people for training and ensuring that they are properly trained. In Russia the first of these problems has been dealt with by making engineering one of the most attractive careers, both in rewards and esteem. As regards the second the provision of buildings has lagged behind the growing demand for engineers. It does not appear, however, to have limited the numbers accepted for training since, where necessary, the institutes work two shifts. It is further recognised that staffing is much more important than buildings and equipment, and this problem has again been partially solved by making the work more financially attractive than that in industry.

Technical Courses

In proportion to the population Russia trains three times as many professional engineers as we do. Full-time courses have reached their maximum entry at 92,000 per annum, but part-time courses are to be doubled to an entry of 165,000 per annum. Entry into the higher engineering institutes depends on records at school or on examination. There are three to six applicants for each place, but those who fail on the first application may make a second attempt, after one or two years in industry. The full-time courses last from five to five-and-a-half years, the number of hours of study being from 4,500 to 5,000 and the six-day week being universal. In these courses the tutorial system is freely used. Evening courses require four attendances a week of four hours each for six years or more—a total of 3,000 hours. There are also well-organised correspondence courses of good status. The success rate is from 85 to 90 per cent. The award of a diploma qualifies the candidate to practice as a professional engineer, but the withholding of the award until some practical experience has been obtained is being considered.

The impression gained by the team was that the courses are designed for technicians and that the syllabus is particularly well suited for that purpose. The standard is apparently somewhere between Ordinary and Higher National Certificate levels in the "speciality" subject, but the treatment is broad and the type of teaching different. At first there was a good deal of criticism that the syllabuses and textbooks were written for a higher and academic level, but those now in use are appropriate for their purpose.

Dr. Willis Jackson (Metropolitan-Vickers), who opened the discussion, said that the importance of engineering to the national economy and security was established in the public mind in Russia to a much higher degree than had yet been achieved in this country, although considerable progress had been made here in the last year or two. There was in Russia a high degree of co-ordination between the higher technological institutes and the industry which they served. This resulted partly from the participation in the teaching work, on a substantial scale, of men whose primary employment was in research institutes and in productive industry, but who were fully recognised as members of the teaching staff. This would be essential in this country for the effectiveness of the new advanced colleges of technology. We must come to regard educational institutions on the one hand and Government research and development institutions and industry on the other not as separate and distinct but as mutually-dependent parts of a single organism. It must become commonplace for some people to move from one domain to the other and for some to be fully recognised members of both.

Sir Gilbert Fleming (Permanent Secretary, Ministry of Education), referring to the influence of industry on education, said that in the technical colleges of this country, particularly with the newer sandwich courses, fresh openings were being explored in this direction. If such courses could be built up into a real unity, to which both halves contributed their proper influence—and some of the experiments now going on showed that that could be done—we should find in our own way the solution to this problem which the Russians had found in their way.

A team which had investigated the schools in Russia had found that the number of pupils taking the full ten-year course to the age of 17 was increasing rapidly. They followed what was practically an undifferentiated curriculum throughout, and at the age of 17 almost all of them tried to get into some form of higher education, but only one-third succeeded. The engineering institutes stood high among the places which they tried to enter.

Sir Paul Sinker (Director-General, British Council) said that one of the jobs of the British Council was to recruit people for educational posts overseas. There was a flattering demand for British teachers of every kind. Not only did this bring us prestige, but it also produced tangible results. So far as the teaching of the applied sciences was concerned, there was truth in the saying that "trade follows the professor." The full opportunities could not be seized, however, for lack of men. There existed, therefore, an opportunity for the Soviet Union which was only too obvious and of which they would not be slow to take advantage. That was one more argument for increasing the provision of technological education in this country.

Professor Lenkowski and Professor Smolinski described what was being done in engineering education in Poland.

Women Engineers

Mr. C. T. Melling (chairman, Eastern Electricity Board), who had visited Russia with Lord Citrine's delegation from the supply industry, said that one great difference between the two countries lay in the adoption by women of engineering as a career in Russia. He had been told by one Russian professor, however, that although the women students passed their examinations and did their diploma work with the same thoroughness

as the men, on an average after graduation they were not so good as engineers. On the question of the further education of graduates, he said that there were academies which admitted, for the electricity supply industry in Russia, 100 students a year after five years' industrial experience following graduation. They were then given a two-year course in higher mathematics, higher technology and management subjects, and were then available for higher appointments.

Viscount Waverley said that against the background of the Russian system it was easy to give the teaching profession the position which it ought to have if national requirements for technological education were to be satisfied, but the impossibility, under the British system, of differentiating teachers in one group of subjects from teachers in general made it difficult to see how what was obviously a glaring need could be met.

Mr. J. F. Coales (Cambridge) said he had the impression that in Russia the fundamental teaching in the first three years must be very well done, but in this country it left a great deal to be desired. It was stated that the Russian engineer, after graduation, was comparable to the British engineer after his training in industry, but the Russian would then be a year younger without taking account of national service. It was stated in the report that in industry the Russian student worked not on the shop floor but as assistant to another engineer, sometimes in a junior managerial position. Mr. Coales thought that was a great advantage, and hoped that the Russian practice of not taking a graduate back for postgraduate training until he had done three years in industry would be adopted in this country.

The members of the team responsible for the report then replied to the discussion. Mr. H. E. Dance (H.M. Inspector of Schools, Technical Branch) regarded the problem of bringing into teaching engineers who were in practice as no less urgent than that of finding full-time teachers. Unless it was solved, some of the proposals for integrating sandwich courses and doing projects within them would not be realistic.

Dr. B. N. Cole (Birmingham University) agreed that against the background of this country it would be inappropriate to aim at the production of 50 per cent professional women engineers, but pointed out that in engineering teaching departments in this country there were under one per cent of women students at present.

Professor A. S. T. Thomson (Royal College of Science, Glasgow) said that the only way to get additional technologists needed in this country was to have very many more good science teachers in the schools, which could be done only by raising their prestige and paying them higher salaries.

Mr. G. S. C. Lucas (B.T.H.) said that the Russian engineers who had visited this country had been very impressed by what they saw, but could not understand how students here learnt their speciality.

Mr. E. G. Sterland (Bristol Aeroplane Company) described a school for qualified labour at the Moscow automobile plant. The school, in a factory employing 40,000, had 850 pupils of both sexes who attended for two years, doing three days a week in class-rooms, where they reached the level of the Intermediate City and Guilds and three days in the workshops, where the standard was very good indeed.

Mr. W. K. Brasher (secretary, I.E.E.), winding up for the team, said that the holder of an institute diploma in Russia should certainly be classified as a professional man, at about the level of the American second degree. In fundamental science and general engineering knowledge the Russian graduate would be a little narrower than the British, but his specialised knowledge would be that of a British graduate three years after graduation. During the second of his practical training years, and more particularly in his first year of staff appointment, the British graduate would be beginning to acquire the specialist skill with which the Russian was turned out from the institute.

When, in the not distant future, the Russians felt that they had improved their standard of living to an extent which would keep their own people happy, they would turn to competing in what we used to call our own markets. We must be ready to meet that competition and have adequate numbers of the right quality to do so.

WIRING REGULATIONS INTERPRETED

SINCE the issue of the 13th edition of the Regulations for the Electrical Equipment of Buildings in September, 1955, the Institution of Electrical Engineers has published three sets of interpretations of their provisions (the latest dated 1st March) in response to queries from the membership. Reprints of these are obtainable from the secretary at 6d each. Abstracts of previous replies have appeared in the *Electrical Review* as they have become available and those relating to the third of the series are given below.

A copper earth-continuity conductor reinforcing a lead sheath only assists compliance with the earthing requirements of Regs. 217, 402, 406, 407 and 507. It does not remove the need for bonding a lead sheath at discontinuities (Reg. 402) to obviate the risk of a length of sheath becoming alive under fault conditions.

Regarding the application of Reg. 503 (B) to fluorescent lighting installations, the insulation-resistance test prescribed covers all wiring and accessories in the circuit and has to be carried out before an installation is permanently connected to the supply and therefore when the whole is cold. Apparatus (which term includes lighting fittings complying with B.S. 2467) may, however, be disconnected during such test provided each item is separately tested and has an insulation resistance not less than that specified in the appropriate B.S. or 0·5 megohm, whichever is the greater.

The a.c. ratings given in the tables of the Regulations apply only to 50 c/s. For guidance regarding certain cables carrying 400 c/s balanced three-phase a.c., reference may be made to E.R.A. Report No. F/T191 on tests carried out at the request of the I.E.E. Wiring Regulations Committee. In the extreme example mentioned in this report of 0·2 sq in multi-core cable, the rating for balanced 400 c/s is 25 per cent less than for 50 c/s. The difference in length of run for 1 V drop may be considerably more, particularly for single-core cables in conduit. For small cables the difference may be negligible. The subject is still under study.

Current ratings set out in Tables 12 to 22 and 25 are for cables remote from iron, steel or ferro-concrete (as noted on p. 107). Rating factors for proximity to steelwork, refer to single-core cables and are given in Appendix G. These need not be applied to multi-core cables, which can be taken from, e.g., Table 17 without modification. This point will be considered more fully when the Regulations are next revised.

Mechanical Strength of Transformers

Discussion on I.E.E. Supply Section Paper

OPENING the discussion on the paper presented by Mr. E. T. Norris before the Supply Section of the Institution of Electrical Engineers on 27th February on the "Mechanical Strength of Power Transformers" (*Electrical Review*, 1st March) Sir John Hacking (Merz & McLellan) recalled that 23 years ago he and the author had together closely examined some of the early troubles on the grid transformers. There was then a general feeling that limitations of space, particularly on roads and railways, would make it essential to use single-phase transformers, but the author and his colleagues had put forward a specific proposal for three-phase transformers and had prepared a complete model of the unit they envisaged in relation to the loading gauge. This work must have saved the supply industry hundreds of thousands of pounds.

Mr. L. C. Richards (Metropolitan-Vickers) remarked that the mechanical failures described in the paper occurred under special circumstances which in no way represented normal practice or normal experience. Transformers designed to-day would presumably be more reliable and give better performance. He summarised the three main points of the paper as follows: that circuit impedance should be taken into account in the design; that the stresses were to some extent cumulative but not too badly cumulative; and that it was impossible to apply short-circuit tests to large transformers.

Mr. M. Waters (E.R.A.) referred to the paper as the first anywhere in the world to give a comprehensive theory of the mechanical strength of transformers. Future ideas, therefore, should be based on the theory in the paper.

Short-Circuit Currents

Mr. W. Casson (C.E.A.) said that while short-circuit levels had increased considerably in recent years, the size of transformers had increased also and he did not think the problem had become more acute. There could be few cases in which short-circuit currents through a transformer exceeded 7·4 times the full load. Many dead short circuits still occurred due to switching on with safety earths connected. The possibility of the doubling effect occurring in a transformer when switched in on one winding with the voltage of one phase at zero and with a short circuit on the other winding must surely be the worst condition for mechanical forces.

Mr. F. W. Gee (Ferranti, Ltd.) said that recent researches had ensured that insulation was used more efficiently and therefore in total there was less of it for a given voltage than formerly, and that in itself reduced compressibility.

Mr. E. C. Rippon (C. A. Parsons) suggested that by model testing and by experience they must prove to the customer what was the short-circuit strength of a transformer, but he could not see what was achieved by assigning a short-circuit rating to something which they could not test at all. He asked whether the author could give any other ideas about test criteria, since apparently they could not be tested in the larger sizes and that even those which could be tested could not be examined to make sure there was no damage.

Mr. G. B. Harper (C.E.A.) reported that out of a total of 39 major breakdowns on the 132 kV grid during the first nine years, seven could be directly attributed to mechanical failure, of which six involved transformers manufactured before 1936 and all associated with designs known to be mechanically weak. The seventh involved a defect which was associated with special circumstances. In the remaining incidents, the possibility of mechanical weakness contributing to the breakdown could be ascribed to only three cases, and even for those the evidence suggested that other factors might have been mainly responsible.

Average total breakdowns per annum represented one for every 105 transformers installed and those due to mechanical weaknesses, both known and suspected, one for every 450, of which over 40 per cent of the units were more than 20 years old. The average non-availability of capacity from 1949 to 1955, taking into account all faults which involved tripping of the transformer, assessed on an outage duration basis, was 0·47 per cent of the total transformer hours available per annum.

Mr. G. N. Leech (B.T.H.) pointed out that at the same current density the magnitude of the mechanical stresses in the windings of a transformer increased with the size of unit. The limitation to short-circuit current rating on small transformers was thermal rather than mechanical. Provided the permitted time duration of a short circuit was not exceeded, there was little danger in connecting well-designed small transformers to large systems. As the size and degree of interconnection of a large power system was increased, it appeared that the source impedance was not likely to be reduced below a limit corresponding to a symmetrical r.m.s. fault current of about 15 kA. This corresponded to about 3 per cent reactance per 100 MVA at 132 kV. The figures calculated from this suggested that the future prospect was not as dark as the author thought.

Mr. E. J. Whitcher (L.E.B.) emphasised that the paper did not make him want to "let up" on specifications. He gave figures of faults which indicated the reliability of transformers.

Mr. R. M. Charley (English Electric Co.) said every illustration in the paper showed transformers with disc-type windings, which confirmed his own view that this type of winding was best. Transformers had not only to be safe mechanically under short circuit but also to have adequate impulse strength. The barrel winding, although good as regards impulse characteristics, was not as good mechanically. Manufacturers were prepared to build larger three-phase transformers, the only limitation being that imposed on the transport of heavy weights.

Maudslay Scholarships

THE Councils of the Maudslay Society and the Junior Institution of Engineers have announced the rules for the award of Maudslay scholarships and prizes for 1957. These awards are made with the aid of funds from the Maudslay Scholarship Foundation to assist young engineers in their technical education and practical training. The value of any one scholarship is not to exceed £400 and candidates must not be over 27 years of age at 30th March, 1957. Further information can be obtained from the secretary of the Junior Institution of Engineers, Pepys House, 14, Rochester Row, Westminster, S.W.1, not later than 30th March.

Dr. Hill responding for the guests and (right) Sir Oliver Franks proposing the toast of the Institution

INSTITUTION DINNER

Electrical Engineers in a Changing World

THE annual dinner of the Institution of Electrical Engineers was held at Grosvenor House, London, on Thursday last week, with Sir Gordon Radley, the President, in the chair. Some 1,500 members and guests were present. It was agreed by acclamation, at the suggestion of the President, to send a greetings telegram to the oldest Past-President, Sir James Swinburne, Bt., F.R.S., who had presided at the dinner 55 years ago and who was that day celebrating his 99th birthday.

The Rt. Hon. Sir Oliver Franks, proposing the toast of the Institution, commented on the paradox that while no other great profession had done so much to bring the nations closer together and to promote unity, in fact the world had tended to become fragmented. Fifty years ago the whole world had had one great political capital, London. At the end of the first world war there had been two, London and Washington, and at the end of the second world war three, London, Washington and Moscow. By the end of the Korean war there were five, London, Washington, Moscow, Pekin and Delhi. Our fathers thought that our ideas, our laws and our institutions would in time be copied by the rest of the world, but there were now five places which set patterns. There were continents which no longer looked to our civilisation for guidance, and within that civilisation there had been great changes, as would be seen by contrasting Western Europe with North America.

This country had continually to make adjustments to meet the new situation, and on the whole had done so quietly and well; but occasionally there had been changes dramatic in their suddenness. Last year we seemed to be conquering our domestic difficulties, but in November and early December there had been a crisis and our reserves began to run out so rapidly that drastic action had to be taken. By obtaining credit from the International Monetary Fund and the Export and Import Bank we had been able to buy time. If we did not use that time well we should have bought it in vain.

There was a fairly early limit to what the Government alone could do; it would require the efforts of the people of this country if an answer was to be found which would be adequate and lasting. Electrical engineers must see that their operations in the industries which they guided and led and inspired were fitted to the ultimate solution of the problem. The need for efficiency at home and more exports abroad was greater than ever.

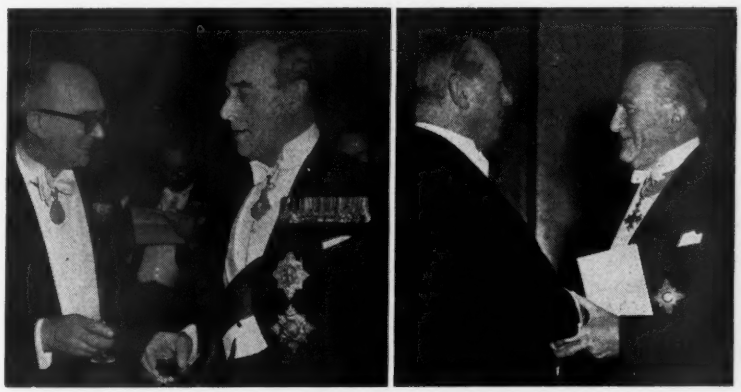
The President, who responded, said that the future of this country depended very largely on engineers. Too often the United States beat us in putting on to the world market what were really the results of work by British scientists. The Russian engineering of nuclear reactors was at a surprisingly high level, and in planning the bulk transmission of power at voltages of about a million they were well in advance. Those countries, moreover, had behind them vast natural resources which we did not possess.

He felt that engineers in this country were not sufficiently aware of the urgency of their tasks. In this age of rapidly increasing scientific possibilities, ten years between the birth of a new idea and the putting of equipment into service was a long time, whether it was a new aircraft design or an electronic telephone exchange. We owed much to the seamen of the sixteenth century who had staked a claim for us in the world geographically, a claim which had resulted in a Commonwealth. In the twentieth century engineers must stake a claim for Britain in the world scientifically. The material wealth of our country lay in what we equipped ourselves to produce, in the power that we generated for industry, in improved transport and communications, and above all in the machines, the products of our brains, which the world should want to buy from us.

Sir George Nelson, Bt., immediate Past-President, who proposed the toast of the guests, referred to the fact that Lord Mountbatten of Burma had become a corporate member of the Institution by examination thirty years ago. The Institution was very proud to have a corporate member as First Sea Lord and Chief of the Naval Staff.

Dr. the Rt. Hon. Charles Hill, Chancellor of the Duchy of Lancaster and until recently Postmaster General, who responded, paid a tribute to Sir Gordon Radley, whose success as Director General of the Post Office was, he said, of profound importance to the electrical engineering profession. Sir Gordon was doing a magnificent job and had demonstrated that first-rate administrators could be drawn from the ranks of scientists and engineers.

Left: The President (Sir Gordon Radley) with Lord Mountbatten. Right: Sir George Nelson greets Lord Mills, Minister of Power



HIGHLAND DEVELOPMENT RETARDED

North of Scotland Hydro-Electric Board's Report

RESTRICTIONS on capital expenditure last year caused temporary postponement of a start on a number of the North of Scotland Hydro-Electric Board's projects which had already been confirmed by Parliament. Work deferred included power stations with a capacity of 37,900 kW and an estimated annual output of 121 million kWh. Moreover, half of the £2,600,000 reduction in expenditure was on distribution, resulting in a much lower rate of development in rural areas and, in total, 2,633 fewer new consumers were connected in the Board's area. Another direction in which the Board's operations were adversely affected by national economic conditions was in capital charges on its schemes; last year it paid £270,000 more in interest than if the rate had been the same as in 1955.

In its report for 1956 published last week* the Board recalls that in June it gave a pledge to the Government that tariffs would not be raised during the year. This came at a time when a drought had cost the Board £1,100,000 and left it, at the end of 1955, with a debit balance of £446,884. During 1956 costs continued to rise so that instead of the last adjustment of tariffs restoring the position there was a loss on the year's working of £165,693, raising the debit balance to £612,577 at the end of the year. The report says that, even with the exercise of the utmost economy, the continuation of these conditions will make it imperative for the Board to reconsider its tariffs.

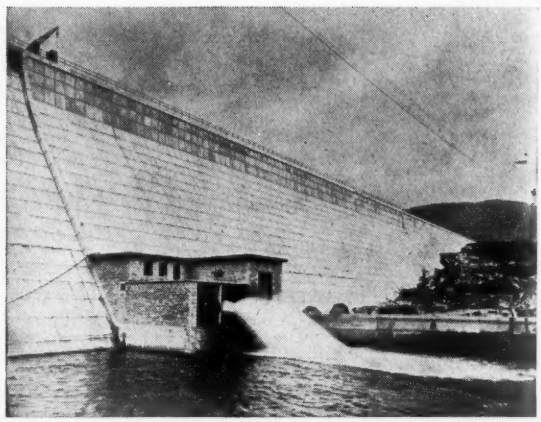
Cost of Rural Supplies

Attention is drawn to the effect of rising prices on the cost of connecting new consumers in the Board's area where longer distances and adverse geophysical conditions make distribution work increasingly expensive. The view is taken that if it is State policy to put electrical power at the disposal of agriculture, then it is a matter for consideration how far the cost of this service in such a scattered area (74 per cent of the land area of Scotland) should be met from the Board's resources or, as in many other agricultural countries, from national funds.

Despite the lower rate of connection the demand for electricity continued to grow rapidly and sales in the Board's area rose by 10 per cent to 1,168 million kWh. This followed a 12½ per cent increase in 1955. This high rate of expansion is attributed by the Board largely to the increased use being made of electricity in agriculture and to the greater attraction of heating by electricity as the price of coal goes up.

The Board's hydro-electric, steam and diesel stations generated 1,744 million kWh last year, 312 million kWh more than in 1955. New plant which became available when the rainfall was high at the end of the year helped to raise the output from hydro-electric plant to the record figure of 11 million kWh in 24 hours. This, it is pointed out, is equivalent to 5,600 tons of coal daily, or nearly 10 per cent of the production of the Scottish coalfields. The year's hydro-electric production of 1,282 million kWh was greater by 52½ per cent than that for 1955 and represented a saving of 715,000 tons of coal.

In contrast to 1955, deliveries to the South of Scotland Electricity Board exceeded by a substantial margin the amount specified in the agreement between the Boards. The total delivered was 362 million kWh and 57 million kWh was imported by the North of Scotland Board. The Board's water storage reserve was also built up by 170 million kWh during the year.



The Cluanie Dam recently completed in the Glen Moriston section of the North of Scotland Hydro-Electric scheme in Inverness. The dam was built by the Mitchell Construction Co.

The maximum demand of the consumers in all areas reached a peak of 377,342 kW in February. The peak export to the South of Scotland Board was 303,000 kW in December and the m.d. on the Hydro Board's generating stations at any one time was 778,000 kW. The average cost of production per kWh was: Hydro-electric 0·64d; steam 0·93d; diesel 1·89d.

Dealing with consumer development, the report records a pronounced increase in the use of electric water heaters and radiators. During the second complete year of occupation and despite an increase in tariffs, the average cost for electricity in 50 Inverness all-electric flats was only £36. The success of these flats, which were the first of their kind to be erected by any local authority in Britain, has influenced other local authorities both inside and outside the Board's area to proceed on similar lines. The popularity of electric cooking among the tenants of the Aberdeen "freedom of choice" houses further increased and the proportion choosing electric cooking has reached 65 per cent.

In the Board's area, 55·5 per cent of the farms and 55·4 per cent of the crofts now have electricity supplies and during the year 88·726 million kWh was used on farms—an increase of 26·3 per cent over the previous year.

Close contact was maintained with all those interested in establishing new industries in the North of Scotland. Two 75 kW diesel generating sets were provided to give a temporary supply to the new seaweed processing factory at Lochmaddy. A new factory was opened by the British Thomson-Houston Co., Ltd., during the year at Buckie for the manufacture of small electrical accessories. Arrangements were made to provide the Cleveland Twist Drill Co., Ltd., at Peterhead with an electricity supply for a new factory to employ initially about 300 people.

* H.M. Stationery Office, price 4s.

Factory space has been obtained at Inverness by Ferranti, Ltd., for the manufacture of small rural transformers. Arrangements are also in hand to provide electricity supplies to several new factories in Inverness.

Discussions continued with the British Transport Commission and other interested parties about an experiment to use a coach with electric battery traction for passenger traffic on a rural railway line and the Board is hopeful that agreement has now been reached to enable the experiment to proceed.

Other industries given a supply last year included new quarries and sawmills, a factory recently established in Angus for the manufacture of dental equipment and another in Kinlochbervie for the processing of crabs and lobsters. Negotiations have been completed for supplying power to a mineral development scheme in the Ullapool district. The temporary arrangements made for a constructional supply to the United Kingdom Atomic Energy Authority's experimental station at Dounreay have been replaced by a permanent supply.

Increased Heating Load

There has been a considerable increase in the use of electricity for heating commercial and non-residential premises. Several County Councils have converted small schools to electric heating and are proposing to use electrical floor heating in a number of large new schools. One firm erecting several offices in the Board's area has decided to heat them entirely by electricity. More church heating installations have been completed. Negotiations are in progress with the Northern Lighthouse Board and Clyde Lighthouse Trust for supplies to further lighthouses and lighthouse keepers' houses around the Scottish coast.

During the year the Board brought into commercial operation a further 101,515 kW of hydro-electric plant. The stage reached in the development of water power is shown in the accompanying table. Good progress was made with schemes under construction and another

Hydro-electric Schemes	Capacity, kW	Average output, million kWh/annum
Already in operation	660,310	1,666
Under construction	210,200	764
Promoted but work not started ...	37,900	121
In course of promotion and survey ...	704,250	1,366
Total	1,612,660	3,917

85,000 kW of plant should be ready for commissioning before the end of this year. In addition, work is well advanced on a new 30,000 kW steam turbine and two 150,000 lb/hr boilers at Carolina Port, Dundee.

As a result of troubles experienced last year the compressor blading of the experimental gas turbine at Dundee has been redesigned and the manufacture of new blading is in hand; this plant should be available for further test runs during the present year. The Altnabreac peat power station in Caithness has been completed and erection of peat handling and pulverising plant has commenced. The manufacture of the 2,000 kW gas turbine plant is nearing completion and there is stated to be a reasonable prospect that the installation will undergo tests this year.

The capacity of the Board's power stations at the end of 1956 was 807,969 kW, more than three times as much as in 1949 (250,970 kW). Of this total 660,310 kW was hydro-electric (85,915 kW in 1949); 102,875 kW steam (131,395 kW); and 44,784 kW diesel plant (32,660 kW).

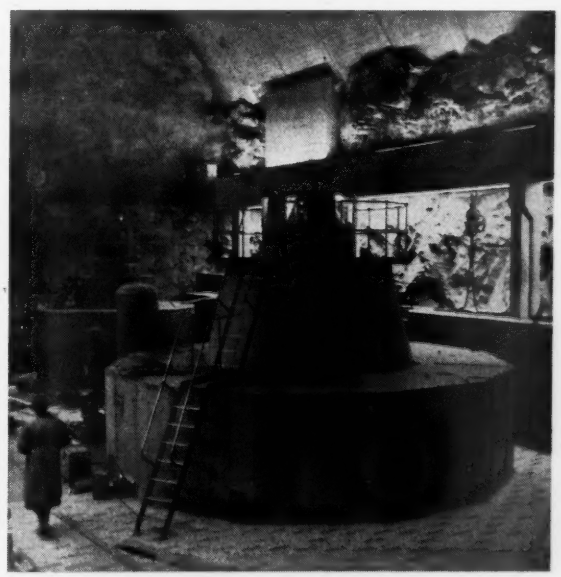
An additional 200 circuit miles of 132 kV lines was brought into commission during the year, making the total 1,480 miles, and a further 310 circuit miles is in course of construction.

At the end of the year the dams at Glascarnoch, Vaich, Fannich, Lednock and Shin were all approaching completion while at Lubreoch approximately 72 per cent of the total concrete had been placed. Fly ash continued to be used in the concrete at Lubreoch and Lednock dams and increased the total saving of cement to approximately 5,500 tons. At Cluanie and Loyne dams, where wet-ground blast furnace slag was used, the total saving of cement amounted to 36,220 tons. Further savings amounting to 10,190 tons were made by using blast furnace slag in the linings of the tunnels at Upper Glenmoriston and St. Fillans.

Among schemes under promotion or survey is one for the utilisation of the water power resources of the River Farrar in Glen Strathfarrar and the River Beauly at Kilmorack, details of which were published by the Board last week.* Another provides for the development of the River Awe and its tributaries, the Nant and the Cruachan Burn. Investigation of pumped storage schemes continues because of the flexibility and operating advantages they offer in association with large nuclear and high efficiency conventional steam stations. Apart from more detailed examination of the development of pumped storage at Loch Awe, site investigations have been carried out at Burn of Mar (Balmaha) and at Loch Sloy, both of which would utilise Loch Lomond. To solve some of the problems which arise there test model investigations have been put in hand.

Investigations into the development of the water power resources of the River Tay at Kenmore and Grandtully were directed mainly to the fishery problems involved. Further surveys were carried out in the area of the Monadhliath Mountains, the Upper River Findhorn, in Glen Nevis and in Skye at the River Snizort. Exploratory

* See page 452.



The interior of the Ceannacroc power station, the first major underground generating station in the country, which came into operation in November in connection with the Glen Moriston hydro-electric scheme. Water is led to it by a tunnel in the main side walls of the machine chamber, and fluorescent lighting gives striking emphasis to this unusual feature

boring work was carried out at the outlet of Loch Laidon to ascertain the best site for a dam there.

To help to meet the steady annual growth of load in the Board's area and provide support for hydro-electric generation in times of drought, additional thermal generation is required from time to time. Consideration is being given to meeting part of this by nuclear generation. A number of likely sites for such a station are being investigated and a contract has been placed for the drilling of trial bores in North-East Aberdeenshire.

The Board was engaged during the year in development and research work in several fields. These included work on electronic fish counters, electric screens and a slotted weir type of fish pass. Trials of underwater television as a means of inspecting screens, intakes, etc., were carried out at Loch Mullardoch in conjunction with the Marconi Company.

The experiments which have been conducted by John Brown & Co. (Clydebank), Ltd., at Costa Head in Orkney on the problem of producing power from wind have been taken over by the Electrical Research Association, and the Board will continue to watch the experiments with interest.

With a view to developing field machinery to take advantage of the low running costs enjoyed by electrically driven barn machinery, preliminary investigations have been made into the use of an electric motor for winch ploughing. This idea has been developed to some extent on the Continent, but there are still difficulties to be overcome before a similar system could be applied to conditions in the North of Scotland.

New hay dryers were installed at Tain, Bonar Bridge and in Strath Halladale. The Strath Halladale dryer was installed in co-operation with the Crofters Commission and the Highland Fund, and though it was late in going into operation, approximately 40 tons of hay were dried.

Operational efficiency in the Board's widely scattered area has been considerably aided by short wave radio. At the end of the year three control stations and four base transmitter stations were in use, with sixty radio-equipped vehicles and twenty-six hand portable units for restricted local work.

Board's Accounts

Income amounted to £10,781,670 (against £8,855,104 in 1955). From this are deducted expenditure other than capital charges £4,544,304 (£5,043,634); redemption fund appropriations and capital repayments £2,086,722 (£1,755,730); and interest and stock management expenses £4,316,377 (£2,837,894). There was thus a net deficiency of £165,693 (against a loss in 1955 of £782,154 before transferring £254,110 from general reserve).

Including an issue of compensation stock to the Central Electricity Authority the Board has issued stock to a nominal value of £130·5 million and at 31st December last nearly £7·4 million was owing to the banks. In the Finance Act, 1956, provision was made for Exchequer advances in place of further stock issues.

Sales in the various categories and the average price received per kWh sold were as follows:—

Domestic and crofts—1955: 420·8 million kWh (1·50d). 1956: 471·8 million kWh (1·63d).

Farms—1955: 70·2 million kWh (1·44d). 1956: 88·7 million kWh (1·57d).

Commercial—1955: 203·3 million kWh (1·76d). 1956: 232·5 million kWh (1·87d).

Industrial—1955: 287·3 million kWh (1·40d). 1956: 307·2 million kWh (1·56d).

Public lighting—1955: 11·1 million kWh (2·17d). 1956: 11·1 million kWh (2·41d).

Traction—1955: 11·4 million kWh (1·22d). 1956: 6·5 million kWh (1·33d).

Bulk supply—1955: 183·7 million kWh (1·78d). 1956: 361·6 million kWh (1·39d).

Illuminating Engineering Society

Proposed Alteration of Name

A FEW months ago it was intimated to the members of the Illuminating Engineering Society that developments since the Society's present constitution was adopted had made a number of changes necessary. They have now been informed that definite proposals have been framed and that an extraordinary general meeting to consider them, and if thought fit to adopt them, is being called for 26th March.

Four resolutions will be put to the meeting. The first is designed to alter the "objects" clauses of the memorandum of association to describe the Society's present activities more accurately and in greater detail. It also gives the Society authority to grant pensions to people who have been at any time employees and their dependants.

By the second resolution the articles of association will be altered to bring them up-to-date. Reference is also made in it to the intended powers of the Council to institute a diploma in lighting engineering. If the proposals to be presented are adopted "diploma membership" will take the place of the present Register of Lighting Engineers. A member who is already on the Register will also be eligible to become a diploma member (Dip.I.E.S.).

Substantial amendments of the by-laws are proposed in the third resolution. *Inter alia*, the definitions of students and sustaining members are set out.

A separate special resolution concerns the changing of the Society's name. The Council recommends that the new title shall be "The Lighting Society" and advances a number of reasons for the suggested alteration. Since the Society's early days, it is said, the practice of lighting and the scope of the lighting engineer have been broadened. The emphasis is no longer on the engineering of illumination and the practice of lighting involves the study and consideration of many other arts and sciences.

One of the Society's declared objects is to attract to it those whose interests lie on the "outskirts" of lighting, ranging from the physiology of vision to the art of decoration or the use of light as a creative medium. The aim was to adopt a comprehensive word which would include "illuminating engineering" and much more besides, and the Council chose the proposed new name as being the simplest, most direct and also the best. A preliminary referendum of members was taken; over 60 per cent replied and of these a majority were in favour of the proposed change.

A consequence of the change would be that the initials for fellows and diploma members would become "F.Ltg.S." and D.M.L.S. respectively.

PARLIAMENTARY REPORT

MR. ARTHUR LEWIS asked the President of the Board of Trade whether he would take the necessary action to amend the Monopolies Act, 1948, so as to enable him to take action to prevent the continuance of the type of restrictive practices described in the Monopolies Commission's Report on the radio valve and electronic tube industry.

Sir David Eccles replied that in so far as the type of practices described in the report were registrable under the Restrictive Trade Practices Act, 1956, they were subject to the procedures laid down in that Act. In the case of other types of practice, the Monopolies Act, 1948, already allowed the Monopolies Commission to be asked to report on the effect of such practices on the public interest, and action under Section 10 of that Act might follow a report of this kind. No amendment of the Monopolies Act, 1948, was therefore needed. He could see no occasion to take any further action in regard to the report.

Strategic Industries and Common Market

In answer to Mr. Page, Sir David Eccles said he thought the proposed Free Trade Area would strengthen most of the industries which were commonly regarded as being strategic. If there proved to be exceptional cases they would have to be considered for special treatment on their merits at the time. Asked whether he would look into the position of the cable makers, he replied, "Yes, but it will be a long time before any trouble arises there."

Reconditioned C.R. Tubes

Mr. John Rankin referred to the reconditioning and re-selling of old cathode ray tubes and asked whether the President would introduce legislation to ensure that adequate guarantees of serviceability were issued.

Sir David Eccles replied that there was no case for legislation. It was for the purchaser of reconditioned tubes to insist upon assurance of their serviceability.

Trunk Telephone Links

In reply to Mr. Ness Edwards the Assistant Postmaster General (Mr. Thompson) said that the technical possibilities of radio telephony were fully taken into account in planning the development of the trunk telephone network. Provision of circuits by coaxial cable was, in many cases, cheaper than by radio-telephone links of equivalent quality.

Euratom

Mr. Maudling informed Mr. Page that Euratom had not yet come into existence, and the United Kingdom had not entered into any agreement regarding the provision of assistance to it. The United Kingdom and the six countries who were negotiating to form Euratom had, however, been taking part, with other countries in Western Europe, in discussions in the Organisation for European Economic Co-operation on collaboration in the field of atomic energy.

British Industries Fair

Asked by Mr. Ellis Smith whether he would reconsider the decision of his predecessor to withdraw the Government grant from the British Industries Fair, Sir David Eccles said he thought that this money could be better spent on showing British goods in trade fairs abroad.

Mr. Ellis Smith asked the Paymaster General if he would arrange either for the provision of exhibits of nuclear power equipment at the British Industries Fair or for the holding of a nuclear power exhibition simultaneously with the Fair.

Mr. Maudling said he was informed that the Atomic Energy Authority would not exhibit at the Fair this year, but would stage a major exhibit at the Safety and Factory Efficiency Exhibition which was to be held at Birmingham from 14th to 21st June. The participation of manufacturers of atomic energy equipment in the British Industries Fair was a matter for them.

Debate on N.C.B. Report

The debate in the House of Commons on the annual report and accounts of the National Coal Board for 1955 was very largely inhibited by lack of information about the Government's future intentions in the field of nuclear power. Mr. Maudling warned the House that, whatever might be achieved in the field of nuclear power, the fact was that in the lifetime of all of them, so far as present knowledge could tell, coal would remain vital to the nation's industrial requirements. That fact could not be repeated too often. He added, however, that the Government's energy programme must remain flexible, because they must be prepared to take advantage of technical changes, which, in the nuclear energy field, were moving very quickly.

For the Opposition, Mr. Alfred Robens said they all regretted very much the lack of a statement on nuclear power, because it was vital to the debate. He, too, emphasised that it should be made clear to the nation, and to the mining community, that coal was the foundation upon which our national fuel and power policy rested, and, indeed, upon which the whole economy of the nation depended. It is a great mistake, and, in his view, it was psychologically disastrous, to over-emphasise the part which atomic energy was to play in the next twenty or thirty years. "If we are not careful about this propaganda the young technicians and scientists coming from the universities might feel that the coal industry was a dying industry and that there was no future for them in that industry."

Mr. George (Conservative) shared the view that the mining industry should be reassured about its future, but he dismissed the suggestion that the "romantic atomic power industry" was attracting scientists from the coal mining industry, and perhaps holding up coal mining development schemes. An entirely different type of technician was required in the atomic power industry.

Ex-Company Pensioners

The Government were accused of "extraordinary harshness" in their treatment of ex-company pensioners of the electricity industry during a brief debate on the motion for the adjournment. Mr. Arthur Palmer, who raised the issue, said that ex-company people had not received anything until November, 1955. It was a very modest increase, and the first they had received since nationalisation. The industry itself wished to make the payment retrospective to April, 1954, but the Minister made the date simply November, 1955, and that only after long delay and much questioning in the House.

In the meantime the Pensions (Increase) Act, 1956, had become law but as in the case of the 1952 Act was not applied to the nationalised industries on the grounds that they were separate commercial undertakings. The Central Electricity Authority had submitted what he understood was an extremely good, all-round comprehensive scheme. But after four months' delay the minimum increase only had been made and only to the ex-local government people; ex-company people would get nothing.

Mr. Maudling said he did not think it could be said there was any obligation on the public authority, when taking over these concerns, to bring everyone up to the level of the best pension rights. It had never been accepted by any Government that the increase of pensions to ex-public employees granted by the Pensions (Increase) Acts of 1944, 1947, 1952 and 1956 should be any precedent for increases of pensions in other spheres. The increase granted to ex-company employees in November, 1955, was not related to the increase in the public service pension because there was no necessary connection between the two.

INDUSTRIAL NEWS

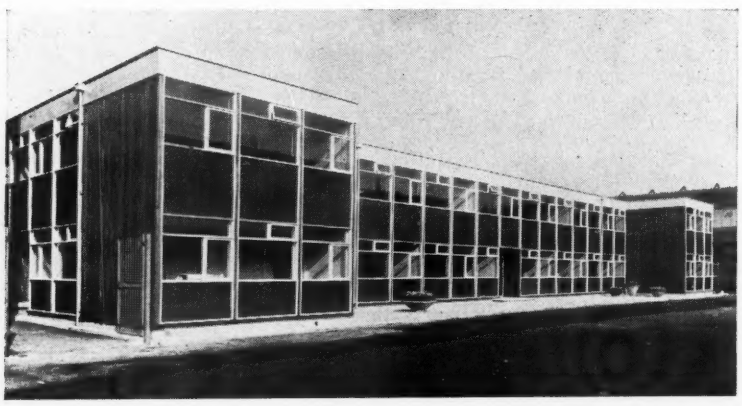
Inquiry into Distributive and Service Trades

The Board of Trade has sent out forms to about 35,000 companies operating in the distributive and service trades requiring them to make a return of their stocks and capital expenditure (and sales, if engaged mainly in retailing) for the year 1956. These returns do not replace the voluntary information already being supplied monthly or quarterly by a number of firms in these trades. The new inquiry, which is being taken under Section 1 of the Statistics of Trade Act, 1947, is the first annual inquiry into the distributive and service trades and forms part of the Government's programme of improving existing sources of information about the economic situation.

New B.T.C. Offices

Last week we had an opportunity of inspecting the new offices which have been erected at Marylebone for the staff of the Chief Electrical Engineer, British Railways Central Staff, British Transport Commission. With the rapid development of electrification under the modernisation plan for British Railways, there has been an urgent need for centralised office accommodation for the chief electrical engineer's staff, and this has been provided at Melbury Terrace, N.W.1. In view of the urgency, a draft scheme based on the use of the "Derwent" timber system of construction, developed by Vic. Hallam, Ltd., was selected. Work on construction was commenced in November last and was completed in the short time of about four months. The new building has two stories with a floor space of 12,700 sq ft. The lighting and all the services are electric. Heating is by convector heaters of 1, 2 or 3 kW made by M. & J. Lossos & Co., Ltd., the entire system being controlled by a time clock with over-riding low temperature thermostats as a frost precaution. In the kitchen and lavatories Sadia water heaters have been installed. The contractors for the electrical installation were the City Electrical Co., Ltd., and the lighting fittings were supplied by Merchant Adventurers of London, Ltd., and Troughton & Young, Ltd. Each office has an electric clock made by Gent & Co., Ltd.

New offices for the staff of the Chief Electrical Engineer, British Railways



Nuclear Contracts for T.I.

Contracts for over 200 miles of tubing, mainly of austenitic stainless steel, have been received by the Tube Investments subsidiary, Accles & Pollock, Ltd., Oldbury, Birmingham, from the A.E.I.-John Thompson Nuclear Energy Co., Ltd., and the G.E.C.-Simon-Carves Atomic Energy Group, who are building the nuclear power stations in Gloucestershire and on the Ayrshire coast. Each reactor will be equipped with "burst slug" detection gear which enables faulty fuel elements to be detected immediately and removed, so preventing contamination of the reactor and heat exchangers. This detection is effected by taking regular samples of gas from inside the reactors, and the tubes ordered are used for conveying these gas samples to the monitoring instruments. Some of the tubes will be supplied in straight lengths and others manipulated and part fabricated.

Japanese Nuclear Power Plan

The Tokyo correspondent of the *Financial Times* has reported that the Japanese decision on the purchase of a nuclear reactor from Great Britain has been deferred until Japanese scientists examine the merits of American designs. The chairman of the Japanese Atomic Energy Commission has referred to two major problems which remain to be solved before an order can be placed—the probable effects of earthquake shocks and the manufacture of special equipment in Japan. In the latter respect the Americans are favourably placed because of agreements with Japanese firms.

It has also been stated that the United States Export-Import Bank would probably advance a substantial part of the cost of the reactor equipment. Mr. Koichi Uda, chairman of the Japanese A.E.C., says, however, that economy of operation is placed above all other factors.

Lamp Trading Terms

The A.E.I. Lamp and Lighting Co., Ltd., has prepared a new trading structure for "Mazda," "Royal Ediswan" and "Metrovick" lamps, and has issued a card (AL.145/2) setting out the discounts on Group 1 and 9 lamps to all recognised users, and standard consignment quantity, with effect from 1st March.

Similar announcements are made by a number of other lamp manufacturers including Thorn Electrical Industries, Ltd., and Ekco-Ensign Electric, Ltd.

Alleged Bribery and Corruption

We reported last week that Mr. G. T. King, purchasing agent with the Metropolitan-Vickers Electrical Co., had been acquitted on a charge of receiving bribes from Fred Gilmour in respect of contracts placed with him on behalf of Metropolitan-Vickers. The case proceeded at the Liverpool Assizes against Gilmour and two others, Cyril Hubert Smith, works engineer, and Arthur Smith, surveyor, employed by Metropolitan-Vickers.

Counsel for Arthur Smith said that there was nothing sinister in the fact that Gilmour's firm became sole contractors for Metropolitan-Vickers' painting work in 1954. All the evidence, except that of Gilmour's competitor, was to the effect that Gilmour's work was very good.

Cyril Smith's counsel said that the car which Gilmour was alleged to have given his client was openly purchased and licensed in Smith's name. The fact that Smith did not pay Gilmour until a year later could simply mean that Smith was a bad payer.

Gilmour's counsel contended that all the charges against his client arose from allegations made by William Rothwell, formerly manager of the decorating side of Gilmour's business.

On Thursday last week, the twelfth day of the hearing, all three defendants were found not guilty and were discharged.

Mr. David Karmel, Q.C., prosecuting, said he would offer no evidence against Gilmour on four further outstanding charges to which he pleaded

not guilty—of forging and uttering forged documents relating to painting work to be carried out at Ferguson Pailin, Ltd., Manchester. The jury, on the direction of the Judge, Mr. Justice Streatfeild, formally returned a verdict of not guilty on these four charges and Gilmour was discharged.

At the end of the case the Judge said that although this lengthy case had resulted in the acquittal of the accused, with which he was sure no one would quarrel, it nevertheless was a very proper case for the police to have brought before the court for full investigation. "One only hopes that, at any rate, it may have a beneficial and possibly purging influence on commercial methods in general," he said.

E.L.F.A. Luncheon

The annual luncheon of the Electric Light Fittings Association will be held on 27th March (12.30 for 1 p.m.), at the Piccadilly Hotel, London, W.1.

Railway Television

British Railways are to put into service in April the first train in the world to be permanently equipped with closed-circuit television for the entertainment of passengers. With a coach fitted as a soundproof studio, the pictures will be seen on 17in monitor sets at each end of the passenger coaches.

All the equipment was designed, and will be installed, by Pye, Ltd., who equipped a similar train experimentally last summer. As a result of that successful demonstration, the Scottish Region of British Railways have decided to make the television train a permanent feature.

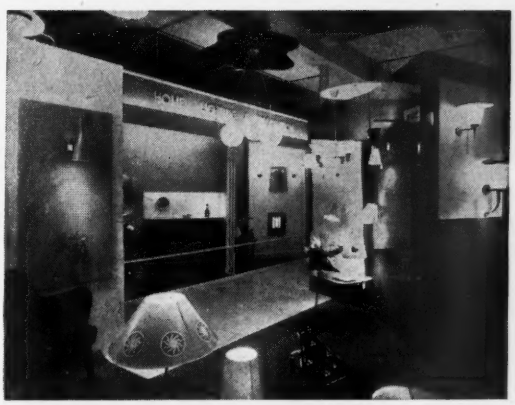
Railway Signalling Equipment for Rhodesia

The Metropolitan-Vickers – GRS, Ltd., has been awarded a contract worth over £1,000,000 from the Rhodesia Railway Board for the supply and installation of c.t.c. (centralised traffic control) equipment between Kalomo and Ndola, a distance of 439 miles. This covers both c.t.c. supervisory equipment and signalling and interlocking equipment, including searchlight-type signals, and is one of the largest orders ever placed for railway signalling equipment of this kind. The new order represents an extension of the 122-mile section from Thomson Junction to Zimba, on which M-V–GRS will shortly be starting to install equipment of similar type, and when it is completed the whole of the main line traffic on some 560 miles of railway will be controlled from four points, Livingstone, Monze, Broken Hill and Ndola, with nearly 100 passing loop sections.

Light and Colour in the Home

The first conference and exhibition on "Light and Colour in the Home" promoted by the Manchester Centre of the Illuminating Engineering Society and held in the Demonstration Theatre, Electricity Service Centre, Town Hall Extension, from 19th to 22nd February was an outstanding success. A "capacity" total audience of 1,200 attended the eight lecture periods and 5,000 people saw the exhibition.

The aim of the event was to provide the fullest information on modern lighting and the part it plays in the design of the modern home. Stress was placed, in the exhibition and during the lectures, on the "marrying" of light with decoration.



Part of the display at the Manchester "Light and Colour in the Home" exhibition

The conference was opened on the first day by Ald. Miss Mary Latchford Kingsmill Jones, a former Mayor of Manchester. The president of the Illuminating Engineering Society, Dr. W. E. Harper, was present at the opening and the chairman was Mr. T. L. Robinson, chairman of the Manchester Centre. At the exhibition leading concerns in the lighting and decorating fields had stands. On each day there were lectures by an expert in some field of lighting design. These were attended by representatives of a large number of official bodies, including women's organisations, colleges of architecture, housecraft and technology, electrical and building trade federations, and similar bodies, and there was a constant flow of members of the general public through the exhibition.

Sign Design Competition

The winners of the £400 illuminated sign design competition sponsored by the Electrical Sign Manufacturers' Association have been announced. The first prize of £100 for the best design of an illuminated sign display for a garage and motor showrooms has been awarded to Mr. A. W. Windsor, of Lee, London, S.E.12, the second prize of £50 to Mr. J. K. Hopgood, of Bromley, Kent, and the third prize of £25 to Mr. R. W. Pepper, of Bickley, Kent. The prize of £25 for the best entry from a competitor under twenty-one years has been awarded to Mr. R. F. Chivers, of West Kensington.

The winners of the prizes for the best designs for an illuminated sign display for a music, radio and T.V. store are: First prize of £100, Mr. L. R. Lewis, of Anerley, S.E.20; second prize of £50, Mr. R. L. Harding, of London, S.E.9; and third prize of £25, Mr. R. W. Pepper, of Bickley, Kent. The £25 prize for the best entry from a competitor under twenty-one years goes to Mr. T. G. Berry, of Manchester.

The judges of the competition were Lord Luke (president, Advertising Association), Professor Sir Patrick Abercrombie, Sir George Pepler, Mr. F. C. Woodward (president, Radio and Television Retailers' Association, who took part in judging the designs for the music, radio and T.V. store only), Mr. F. F. Newlands and Mr. K. J. Oldham, chairman and vice-chairman respectively of the Electrical Sign Manufacturers' Association. The prizes will be presented by Lord Luke at a luncheon on 12th March at the Savoy Hotel, London.

Lifts fo India

One of the largest lift contracts from India has been secured by Marryat & Scott, Ltd., for twenty-eight heavy duty goods lifts at Calcutta Docks. The contract, which includes installation on site, was the result of a joint tender submitted by Marryat & Scott, Ltd., and F. & C. Osler (India), Ltd., against international competition. F. & C. Osler, one of the group of companies controlled by Mr. Haridas Mundhra, has represented Marryat & Scott for twenty-seven years, and plans for closer co-operation between the two companies have already reached an advanced stage. The lifts, for Kidderpore and King George V Docks, Calcutta, are to be delivered over a period of 18 months, and will be capable of handling 1,000 tons of freight per hour.

Holidays-with-Pay Scheme

Specialist Trades Holiday Scheme, Ltd., which operates the holidays-with-pay scheme for the electrical contracting industry, has announced that, from the week commencing 3rd June, the holiday credit is increased as follows:—In respect of journeymen, from 7s 3d to 8s a week; for all adult mates, from 6s to 6s 6d a week.

Metal Finishing Conference

The annual conference of the Institute of Metal Finishing will be held this year at the Grand Hotel, Brighton, from Tuesday, 9th April, to Saturday, 13th April. Various aspects of electro-

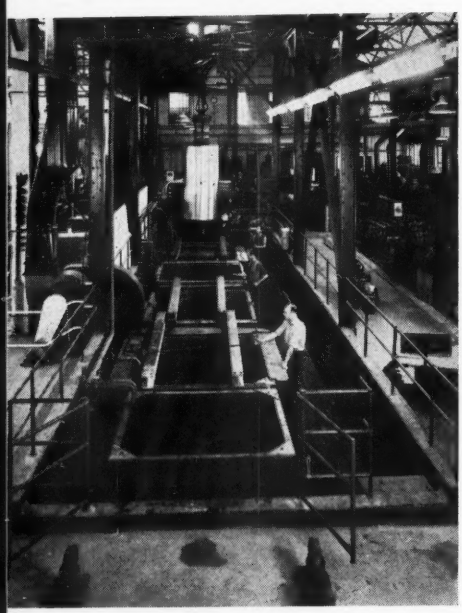
deposition, coating, spraying and finishing will be dealt with in papers presented by experts at morning and afternoon technical sessions on Wednesday, 10th April, Thursday, 11th April, and Friday, 12th April, and in addition there will be social functions in the evenings and on the Saturday morning. There will also be a special programme of visits for ladies attending the conference. Full particulars of the conference can be obtained from the Conference Secretary, 32, Great Ormond Street, London, W.C.1.

Chromium Deposition Plant

New plant for the electro-chemical deposition of chromium which can accommodate components up to 15ft long, 5ft in diameter and weighing up to six tons has just been completed at the Port Glasgow works of Fescol, Ltd. The runway over the five deposition and preparatory tanks has been designed to carry a load of ten tons, so that no structural alterations will be necessary if the weight-lifting capacity should be increased at a later date. The present six ton hoist is arranged for low voltage push-button operation with inching facilities for close control over the load.

The vats are housed in an asphalt-lined pit with the tops on a level with the factory floor. A specially designed system of cooling is used to ensure close control of the temperature of the deposition vats, and enables a heat balance of ± 1 deg F to be maintained. The current supply to the new plant is over three times that provided to any one chromium deposition vat in the company's London works, the electrical supply being through Westinghouse rectifiers and reverse switches. Two groups of the oil-immersed rectifiers, with stepless regulators, are placed close to the vats to ensure a minimum voltage drop in the conductors.

New heavy chromium deposition plant in the Port Glasgow works of Fescol, Ltd.



Manweb Electrical Industrial Development Centre

Leading industrialists in Merseyside, Lancashire and Cheshire were present at the inauguration of the Electrical Industrial Development Centre of the Merseyside and North Wales Electricity Board, which was opened, formally, by the Lord Mayor of Liverpool, Ald. E. Sheehan, on 5th March.

The Centre is in Paradise Street, Liverpool, and is intended to demonstrate new types of electrical equipment and new ways of applying electrical power to industry under normal working conditions.

The Board intend to present a series of different exhibitions, each having a specialist appeal, and each staffed by experts in the particular sphere being demonstrated at the time. The inaugural exhibition, which remains open for two weeks, displays a general range of electrical applications for industry, most of which will be the subject of subsequent displays and demonstrations in the future. Amongst the items which attracted special attention were electro-heating, steam raising, water and liquid heating, electronic control of machines, and lighting.

Radio Trades Examination Board

The report of the chairman of the Radio Trades Examination Board for the year ended 31st August last states that the total of entries for the examinations conducted by the Board since 1944 reached 4,221. The Board received 822 applications during the year to enter for the radio servicing certificate examination and a further 138 for the television servicing examination. The Board has under consideration the desirability of extending its work into fields other than radio and television as, for example, electronic application, although it does not wish to see any duplication of efforts which are already being made by other bodies.

German Nuclear Research

According to the Bonn correspondent of the *Manchester Guardian*, German scientists have discovered how to convert hydrogen into helium at a tenth of the temperature previously considered necessary. The still immensely high temperature required, 10 million deg C, can be achieved by the use of magnetic fields.

Electricity Supply Handbook

The tenth edition of the "Electricity Supply Handbook" is now available from the *Electrical Times*, Sardinia House, Sardinia Street, London, W.C.2, price 10s. While the general arrangement is the same as in previous editions, clearer treatment has been adopted for the maps showing boundaries of areas, sub-areas and districts with location of appropriate headquarters and service centres. The useful three colour folding map showing generating stations and transmission lines has been retained.

The members and chief officers of the Atomic Energy Authority and the new Ministry of Power are listed in this 1957 handbook, the number of pages of which have been increased from 191 to 207.

Birmingham Lighting Exhibition

The A.E.I. Lamp & Lighting Co.'s exhibition, "Systems of Lighting," opened at the "Mazda" showroom, 26, Holloway Head, Birmingham, on 26th February. It is of interest principally to architects and engineers responsible for modern building. Added to the exhibition since it was shown in London is a new range of "Mazda" shop and display lighting fittings.

Export Advertising

The Advertising Association is holding a conference on 20th March, at Church House, Westminster, which will be devoted to the problems of export advertising. The registration fee for delegates is 2 guineas, and further particulars can be obtained from the Association, 1, Bell Yard, London, W.C.2.

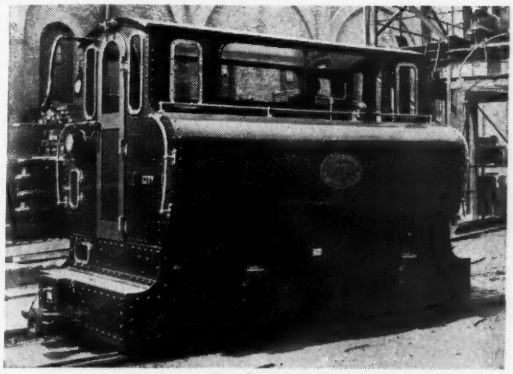
Falk, Stadelmann Veritas-Efesca Works

Falk, Stadelmann & Co., Ltd., inform us that the manufacturing business formerly carried on by them at Veritas-Efesca Works is now carried on there by their wholly-owned subsidiary company, United Electric Co. (Coolex), Ltd., in continuation of the business which until recently that company carried on at 61, Chester Street, Aston, Birmingham, 6.

There is no change in the control of these works and there will be no alteration in the nature or type of product. Manufacture will continue to be carried out at the Edward Street address as previously and all purchase orders or other contracts placed by Veritas-Efesca Works will be taken over by the United Electric Co. (Coolex), Ltd.

Historic Locomotive

Equipment from a 57-year-old City & South London Railway electric locomotive has been presented by the British Transport Commission to Crompton Parkinson, Ltd., for inclusion in its historical collection. One of thirty-six similar locomotives, built by the former Crompton & Co. between the years 1897 and 1901, this particular locomotive, No. 36, was commissioned in 1900, ten years after the railway had been opened. All the Crompton locomotives were fitted with two gearless motors and were capable of hauling a four-car train even if one motor was out of commission. When the line was converted to multiple-



The City and South London Railway No. 36 electric locomotive

unit traction in 1926, No. 36 was one of the two locomotives not scrapped. After being reconditioned and repainted in its original livery, it was placed on display at Moorgate Station. When the station was bombed during the war the locomotive was extensively damaged. In view of the fact that a complete City & South London locomotive (bearing the plate "No. 1" although not the original locomotive of that number) is on view at the South Kensington Science Museum, it was recently decided to offer No. 36 to Crompton Parkinson, Ltd., successors to the original makers. The difficulties and cost of removing it as a whole would have been very considerable, and Crompton Parkinson decided to take such parts of it as it considered to be of particular interest, namely the two motors with wheels and axles, a resistor and the two original nameplates. These parts will be renovated where necessary for exhibition purposes and will be kept in the company's historic collection at the Chelmsford Works.

Batti-Wallahs' Society

The guest speaker at last week's luncheon of the Batti-Wallahs' Society was Mr. John Connell of the *Evening News*, who, in an amusing address, spoke on the responsibilities of the Press. Mr. W. C. M. Couch (president) was in the chair. Mr. T. C. F. Bigland (the "Mate") announced that the speaker at the next luncheon (Wednesday, 27th March) would be Mr. Ernest Blake (director of Kodak, Ltd.).

Turbine Operators' Course

The City and Guilds of London Institute has recently been asked to devise a course and to conduct examinations in steam turbine plant operation, in order that there may be some recognised qualification for those who actually operate the plant, e.g. turbine drivers.

The Central Electricity Authority, together with other major industrial users of turbine plant, such as the British Iron and Steel Federation, the British Paper and Board Makers' Association, Imperial Chemical Industries, Ltd., and Courtaulds, Ltd., are represented on the Institute's Exploratory Committee, together with representatives from various educational organisations and the Ministry of Education. This committee held its first meeting in December last and decided to draw up a syllabus for a course with a strong practical element, comparable in certain respects with that for the boiler operator's certificate. The examination will comprise both a written paper and a practical/oral test. The details of the scheme are at present being worked out by the Syllabus Sub-Committee and it is hoped to publish the regulations and syllabus for the examinations within the next three months.

Trolley-Buses for Portugal

An order has been received by the British United Traction Co. for the supply of seventeen trolley-bus chassis for Oporto, Portugal. The electrical equipment will be supplied by the Metropolitan-Vickers Electrical Co., Ltd., and the bodies will be built in Portugal to British designers' approval.

Lighting Service

The General Electric Co., Ltd., has issued "The Reality of a Complete Lighting Service," a booklet in which it describes the experience, resources, design, manufacture and advisory service that lie behind the many examples of lighting development illustrated in its pages.

Tin Plate Workers' Travelling Scholarships

The Worshipful Company of Tin Plate Workers alias Wire Workers of the City of London, announces that the first place in the essay competition amongst those awarded travelling scholarships, 1956, has been gained by Lewis Myrddin Davies, employed by the Steel Co. of Wales. The second place goes to Peter Brian Spencer, employed by I.C.I. Metals, Ltd., Witton, Birmingham, and the third place to Samuel David Ferguson, employed by the Merseyside and North Wales Electricity Board at Crewe. Mr. H. S. Pocock and Mr. P. L. Garrett acted as assessors.

F.B.I. Publications

We have received two booklets from the Federation of British Industries, 21, Tothill Street, London, S.W.1. The first, "Britain's Economic Problems" (price 3s), summarises in 34 pages the position of Great Britain in the world economy, with particular reference to the balance of payment and reserves. It deals with the causes of to-day's uncertain equilibrium and inflation and indicates the way in which stability should be established.

The other publication, "The Budget, 1957" (price 2s 6d), contains the Federation's annual representations to the Chancellor of the Exchequer in advance of the Budget date. It is in two parts: the first deals with broad questions of fiscal policy and outlines essential tax charges, and the other proposes a number of technical changes in tax law.

Management Conference

The British Institute of Management and the Institute of Industrial Administration are holding a conference at Southport from 22nd to 24th March at which the theme will be "Speeding Management Decision."

Proposed Kenya Contracting Company

A report in *The Times* from Nairobi says that Mr. N. G. Bailey has announced that he intends to recommend to the directors of his company that they should form an electrical contracting company in Kenya to serve East African territories. N. G. Bailey & Co., Ltd., who have branches in Leeds, Manchester and London, are members of the Electrical Contractors' Association.

Change of Address

The head office of the Incorporated Plant Engineers is now at 12, The Parade, Solihull, Warwickshire (telephone: Solihull 1111).

Trade Announcements

Everett, Edgcumbe & Co., Ltd., Colindale, N.W.9, have opened an area office at Columbia House, Aldwych, London, W.C.2 (telephone: Chancery 5953/4). Mr. J. S. Lasenby will operate as technical sales engineer in London and the Home Counties, responsible to head office Sales Department under the control of Mr. W. E. House. Mr. J. McManus will act as special engineering representative, and he will be available either at head office or at Columbia House.

The **Jackson Electric Stove Co., Ltd.**, has appointed Mr. E. C. Bennett as its representative to cover the Midlands Electricity Board area; he will be attached to the company's Birmingham branch. Mr. W. M. MacFarlane is appointed as a representative attached to the company's Scottish office, Glasgow.

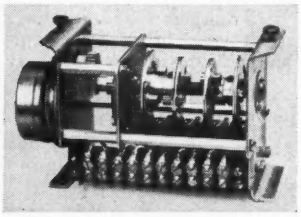
The Middlesbrough branch office of **Honeywell-Brown, Ltd.**, has moved to 52-60, Fletcher Street, Middlesbrough (telephone: Middlesbrough 44221/3).

Mr. R. Sanders has been appointed representative for **Hague & McKenzie, Ltd.**, for the Greater London area. Until recently he represented Bradley & Co., Ltd., of Bilston.

NEW ELECTRICAL EQUIPMENT

Self-Resetting Sequence Timer

The "Rodene" self-resetting Type 2600 multi-circuit timer or sequence controller announced by D. ROBINSON & Co., 58, Oaks Avenue, Worcester Park, Surrey, is intended for such purposes as starting slip-ring motors, circuit-breaker reclosing, and mechanical handling where a sequence of events must occur at predetermined times after a starting signal. Drive is provided by the self-clutching forward-running "Rodene" synchronous



"Rodene" self-resetting Type 2600 multi-circuit timer or sequence controller with cover removed

motor and each circuit has a 5 A snap-action switch operated by an easily preset steel cam.

There are two standard models. One can run for up to 15 sec and control up to four circuits; the other runs for up to a minute and controls up to eight circuits. The operation is that when the shaft has turned through 300 deg it is stopped and held, but interruption of the motor supply at any time results in a spring driving the shaft back to the start position.

Alternative models can either run continually without resetting, or turn through 360 deg and then stop until a switch is changed over when it will make a further revolution. These units can have speeds down to one revolution per week.

Counting Sub-Units

Plug-in counting sub-units now being produced by the Instrument Division of ERICSSON TELEPHONES, LTD., High Church Street, New Basford, Nottingham, offer a new approach to the problem of nucleonic and industrial scaling, counting and timing and the application of digital techniques to industrial control.

By means of a number of power units and a wide range of plug-in sub-units an almost infinite variety of instruments may be quickly assembled. Various ranges provide for counting speeds from 6 p.p.s. to 200 kc/s. Speeds up to 5 p.p.s. are counted on resettable or non-resettable electro-mechanical registers, while speeds up to 350 c/s are obtained on Ericsson Dekatron units employing cold cathode tube coupling stages. For speeds up to 20 kc/s the Dekatron units utilise a hot cathode drive stage while binary units are capable of counting speeds up to 200 kc/s.

Wire-Wound Resistors

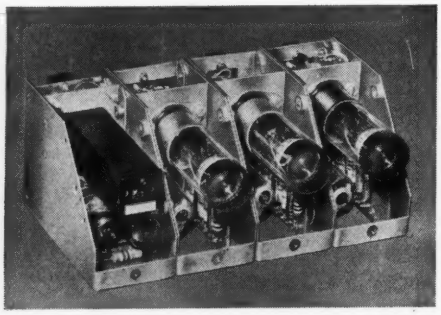
A modified form of vitreous enamelled wire-wound resistor is announced by WELWYN ELECTRICAL LABORATORIES, LTD., Bedlington, Northumberland, under the designations V1, V2 and V3.

The vitreous enamel is claimed to be completely homogeneous and free from pin holes and porosity. In the resistors no joints between dissimilar materials are made beneath the surface of the enamel, the leads emerging from the enamel being of the same material as the wire used in winding the element.

The resistors are manufactured in three sizes corresponding to the Radio Components Standardisation Committee's patterns RWV4-J, RWV4-K and RWV4-L.

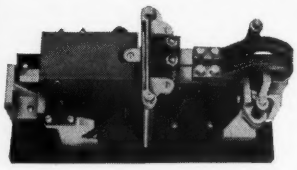
High Speed Contactor

The latest addition to the range of single-pole high speed contactors manufactured by HIRST ELECTRONIC DEVELOPMENTS, LTD., Gatwick Road, Crawley, Sussex, is rated at 1,200 A at 440 V a.c. and 1,200 A at 120 V d.c. and is finding wide use in such applications as continuous electrode welding, spot welding, furnace control, and for ground power aircraft starters. It has connections suitable for busbars which can be taken out from either side or to the back. With its very heavy blow-out, laminated iron circuit and specially designed arc chute, the quenching of the arc is both rapid and certain. It has self-aligning and adjustable contacts, faced with special alloys. The overall dimensions are 20 by 9 by 12in.



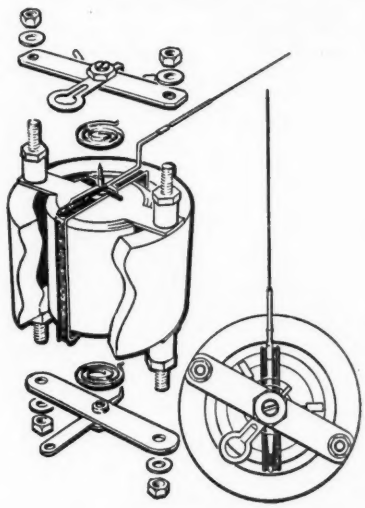
Left: Typical seven digital counter assembled from Ericsson sub-units

Below: Hirst Electronics 1,200 A 440 V s.p. high speed contactor



Moving Coil Meters

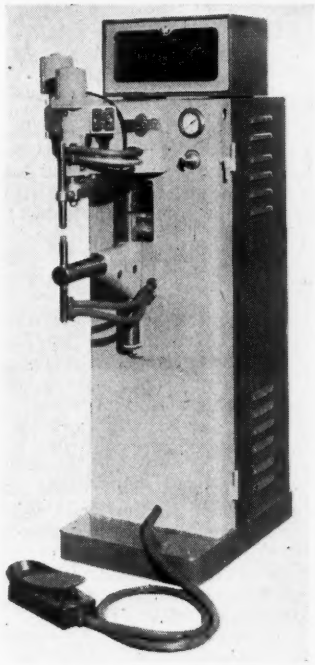
A new patented design of moving coil centre pole meter is now being manufactured by TAYLOR ELECTRICAL INSTRUMENTS, LTD., 419-424, Montrose Avenue, Slough, Bucks. Torque over power ratio is stated to be at least twice that of conventional movements. Other features are extreme robustness and rigidity, very high sensitivity and a novel method of dry balancing. Basically the movement consists of a centre cone magnet surrounded by a soft iron ring, where the coil revolves round the magnet. The meters can be used both horizontally and vertically without zero error and are made in sizes from 2in to 5in scale lengths.



Components of Taylor moving coil meter

High Speed Spot Welder

A new series of high speed, air operated, spot welding machines, termed the "Sciaky Rapid" range, is offered by SCIAKY ELECTRIC WELDING MACHINES, LTD., Falmouth Road (Trading Estate), Slough, Bucks. These welders are available in three main sizes of 15, 25 and 50 kVA nominal, all with optional throat dimensions up to 36in maximum. A four channel thyratron timer is employed giving variable "squeeze,"



Sciaky high-speed spot welder

"weld," "dwell" and "off" periods. The pneumatic system is designed to permit very high welding speeds and the 15 kVA model will weld at up to 250 spots per minute. Particular attention has been paid to ease of operation and maintenance in the design of these welders so that high production rates can be achieved with the minimum idle time between runs.

Sealing Beads

Sealing beads are now being produced by the ENGLISH GLASS CO., LTD., Empire Road, Leicester. These beads have hitherto only been made in the United States and manufacturers in this country have had to improvise by cutting segments from selected tubing.

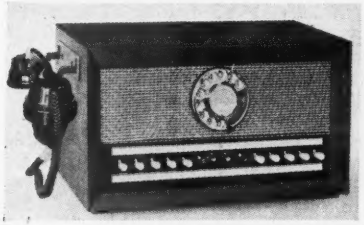
"Englass" sealing beads are made by an accurate moulding process, and can be held to close limits on diameter and bore. Various shapes can be made to suit the user's design and application. Both borosilicate and soda glasses, clear and coloured, are available. Due to relatively low tool costs small quantities can be produced for experimental purposes.

Loudspeaking Telephone

The General Electric Co., Ltd., has developed a loudspeaking telephone for use on private automatic exchanges. It incorporates a voice-operated switching circuit which automatically controls reception and transmission. This switching circuit replaces the manually operated talk/listen switch used in other loudspeaking telephone systems.

The differential switching of microphone and loudspeaker paths is accomplished by shunt elements with conductivities which vary with the magnitude of the impressed voice signals. When a speech signal is connected to the amplifier, in either direction, the wanted through connection is made and the unwanted path is attenuated. If both parties speak at once, the louder signal takes the path and the other is suppressed.

The equipment consists of a desk-mounting cabinet, housing the loudspeaker and microphone, and an amplifier unit which is designed for wall-mounting and can be remote from the telephone. Any number of these equipments may be installed on the same exchange system. A conventional handset on the side of the cabinet can be used for confidential conversations, the loudspeaker being switched off when the handset is lifted. The user may also prevent a



Loudspeaking telephone fitted with direct-access keys

distant caller from hearing a local conversation by operating a key to switch off the microphone.

In addition to automatic dialling, a system of direct-access calling is provided which enables up to twenty of the extensions most frequently required to be instantly obtained by operating the appropriate key. The equipment is marketed in Great Britain by the RELIANCE TELEPHONE CO., LTD., 39-41, Parker Street, London, W.C.2, a subsidiary of the G.E.C.

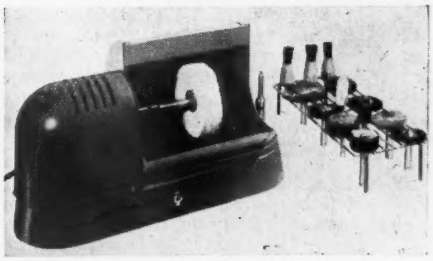
Polishing Machine

A compact industrial polishing machine designed for the scientific instrument trade, jewellers, dentists, etc., is now being manufactured by J. M. GLAUSER & SONS, LTD., Bensham Manor Road, Thornton Heath, Surrey. It is 12in high by 20in long and is normally powered by a continuously rated ⅛ h.p., 2,800 r.p.m. capacitor motor at 230/250 V. Motors of other voltages and speeds can be supplied to meet the needs of various trades. The weight of the machine is 22 lb.

Quick-change sleeves are fitted to the brushes and this also enables the tools to be reversed, considerably lengthening their life. A dust hood collects any flying particles into an easily removable tray.

Brushes, polishing mops and other tools ranging from the smallest up to 6in in diameter can be supplied as well as specially designed tool racks. The machine, finished in white or Admiralty grey, is priced at £28 10s.

Glauser industrial polishing machine. A specially designed tool rack is shown alongside



Rotary Switch

The range of components made by AUSTINLITE, LTD., Crawley, Sussex, has been extended by the addition of the type A 15 rotary switch. This is a compact multi-cell switch which can be assembled to provide many hundreds of different contact combinations. It embodies all of the features of the larger switches in the Austinlite range and despite its compactness it is liberally rated at 15 A, 250 V, or alternatively, 7½ A, 440 V. It is suitable for direct-on-line starting of three-phase induction motors up to 5 h.p.

Austinlite type A 15 multi-cell rotary switch

The switch indicated in the photograph is arranged for change-over switching up to 12 poles.

Nylon Cable Clips

Cable clips made from a nylon insulating material are now available from METWAY ELECTRICAL INDUSTRIES, LTD., Canning Street, Brighton, 7. They are supplied, complete with carbon steel pins, in packets of fifty at a price of 2s 6d per packet. Substantial quantities, in bulk, are obtainable at special prices.

Sealed Instruments

FERRANTI, LTD., Hollinwood, Lancs., announce that they have been successful in obtaining full type approval for their 2in sealed instruments which cover humidity Class H1 requirements and temperature category 40/85.

Ferranti 2in sealed instrument

GENERATION AND DEVELOPMENT

C.E.A. Contracts

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines, amounting in the aggregate to £17,067,800. They include the following:—

Northfleet power station: Four oil fuel storage tanks.—Tees-side Bridge & Engineering Works.

South Denes power station, Yarmouth: Two 550,000 lb/hr boilers. — Mitchell Engineering.

Spondon H.P. power station, near Derby: Main foundations.—J. Gerrard & Sons.

Rugeley power station: Two 120,000 kW reheat boilers.—Babcock & Wilcox.

Aberthaw power station: 132 kV, 3,500 MVA switchgear.—Ferguson Pailin.

Skelton Grange " B " power station, Leeds: Four 120,000 kW reheat boilers.—Mitchell Engineering. Sidings.—B.C.S. (Engineers and Contractors).

Agecroft " B " H.P. power station, Salford: Superstructure, roads and drains and ancillary buildings.—M. J. Gleeson (Contractors).

Capenhurst substation: 132 kV, 3,500 MVA switchgear.—English Electric Co.

Checkerhouse substation: Two 60 MVA, 132/33 kV transformers.—Bruce Peebles & Co.

Fleet substation: 275 kV, 7,500 MVA switchgear.—Metropolitan-Vickers Electrical Co.

High Marnham substation: Site and foundations.—M. J. Gleeson.

Various 275 kV substations: 275 kV busbar earthing equipment.—Power Connectors.

High Marnham-Keadby-Monk Fryston: 275 kV overhead line.—British Insulated Callender's Construction Co.

River Severn and Wye: Special foundations, access gantry and roadway.—Holland & Hannen and Cubitts.

Scottish Reinforcement

The South of Scotland Electricity Board has approved a scheme, estimated to cost £665,000, for reinforcing the electricity supply in Grangemouth and district so as to provide for the rapid industrial development in that area. A new grid substation will be established at Bainsford, to the north of Falkirk, to provide supplies to Grangemouth, Bo'ness and Bainsford by means of a new 33 kV system. The voltage of the distribution networks in Grangemouth and Bo'ness will be raised from 6·6 to 11 kV. Provision is also being made for a reinforcement of the supply in the Burgh of Falkirk where a new substation will be constructed in Manor Street. It is hoped to complete the whole work by 1959.

With a view to improving the electricity supply in the Carntyne district of Glasgow and providing for increasing loads there, the Board has approved a scheme of reinforcement at an estimated cost of £49,800. Five new substations will be constructed and extensions made to the distribution networks. The scheme will be completed during 1958.

To meet the growing electrical load in the eastern area of Fife, the Board has also approved a reinforcement scheme estimated to cost £124,600. Reinforcement will be effected by the construction of new 33 kV lines between Cupar and Durie House (Leven), St. Andrews and Kingsmuir and of a new 33 kV substation in St. Andrews. The work will be completed during 1958.

Higher Charges in South West

The South Western Electricity Board has announced increases in tariffs which are to take effect after the first meter readings following 1st April (i.e. consumers will receive their first bills at the new tariffs after the end of June). The Board says it is now essential to revise tariffs in order to cover the increases in costs which have occurred in the last two years, including a very heavy rise in the cost of coal, and to provide for the expanding capital programme which must be undertaken.

The changes in block tariffs for domestic and other consumers are as follows (with existing prices in parentheses):—First block, per kWh, 7d (6d); second block 2½d (same); all additional consumption at 1⅛d (1d). It is pointed out that the 1d running charge, which applies to three-quarters of the total sales to domestic consumers, was fixed in June, 1953, since when the cost of coal has risen by 30 per cent, or more than £1 a ton.

The South Western Electricity Consultative Council states that after full investigation it has agreed unanimously to endorse the Board's proposals for tariff revisions as being the most fair and equitable way of meeting the higher costs of coal, labour and equipment and helping to finance the industry's capital development programme in the West Country.

Strathfarrar and Kilmorack Scheme

The North of Scotland Hydro-Electric Board last week published details of the Strathfarrar and Kilmorack Scheme (Constructional Scheme No. 30) by which it is intended to harness the waters of the Rivers Farrar and Beauly for the production of 268 million kWh a year. The catchment area covers 350 square miles in the counties of Inverness and Ross and Cromarty. The flow from this area will be utilised in four power stations with a total installed capacity of 102,000 kW. Two of these will be in the Kilmorack Gorge and two in Glen Strathfarrar. The Kilmorack stations will use the flow not only from the two stations in the glen but also from the Fasnakyle power station the regulated discharge of which is controlled by Loch Mullardoch and Loch Benevean, the reservoirs of the Affric scheme. At present prices the estimated cost of the scheme is £14,250,000. The construction of the works will take about five years and a peak labour force of between 750 and 1,000 workers will be employed.

The available fall in the River Farrar will be developed in two power stations. The upper section will include a dam 110ft high across the river about one mile downstream of Loch Monar. There will also be a subsidiary dam 50ft high in a low saddle to the west of the main dam. From Loch Monar the water will be led by a tunnel 5¾ miles in length to a power station near Deanie at the west end of Loch Beannachran. This station will have an installed capacity of about 38,000 kW.

To supply the lower power station, Loch Beannachran will be raised in level by about 8ft. This will be done by a small dam three-quarters of a mile downstream from its outlet and, from the upstream side of the dam, a tunnel 3½ miles in length will lead water to the Culligran power station on the left bank of the River Farrar downstream of the Culligran Falls which will have a capacity of about 24,000 kW.

It is also proposed to pass the waters of the River Beauly through two power stations. This will involve the construction of two dams, each about 50ft in height and each with a power station of about 20,000 kW capacity built into the dam.

Objections to Supergrid Line

Surrey Planning Committee is asking for a public inquiry to be held into the Central Electricity Authority's proposal to erect a 275 kV line from West Weybridge to Chessington as part of the national supergrid. It is reported that already objections to the scheme have caused a year's delay. Esher Council is seeking verification of an estimate that to put part of the line underground would cost £1½ million. Woking Council is also objecting to the project.

School Supply Terms Criticised

Referring in a report to electricity supplies to new schools, Oxfordshire Education Committee says that it is informed that when new schools are built the Southern Electricity Board usually requires not only a guaranteed minimum revenue but, in some cases, also a contribution towards the capital cost of bringing the service to the school.

The Committee does not consider that such conditions should be

accepted unreservedly. It has given instructions that any request for both a guaranteed minimum revenue and a capital contribution for the same school should be "strongly resisted."

Nuclear Station may be Duplicated

At a conference at Taunton on Monday Lord Hylton, chairman of the Somerset County Planning Committee, said his Committee would recommend that a public inquiry should be held into the Central Electricity Authority's proposal to build a nuclear power station at Hinkley Point, Bridgwater Bay, so that the 19 objectors to the scheme could be heard. The C.E.A. had informed them that they must not rule out the probability of the station being duplicated about five years after the initial installation should the generation of electricity from nuclear power continue on its present lines. A second station would not necessarily resemble in bulk or layout the one now proposed in view of the continued and rapid development in the use of atomic power.

The C.E.A. is being asked to say whether the Authority is prepared to accept certain modifications and conditions affecting the project so that its reply can be considered by the Planning Committee immediately before the next County Council meeting on 26th March.

Floor Warming

Liverpool Corporation Housing Committee has decided to make an experimental electrical floor warming installation in a block containing four two-bedroomed flats and eight three-bedroomed flats. The city architect has been authorised to approach the contractors concerning the necessary modifications to the structure of the buildings and the electricity authorities to inquire about the technical aspects of the installation.

Postponement of Trolley-bus Conversion

Darlington Town Council has been asked by the Ministry of Transport to postpone its plans for converting its last trolley-bus route to motor-buses until after the fuel emergency.

OVERSEAS

Rhodesian Development Problems

In his latest annual report just received, the city electrical engineer of Salisbury, Southern Rhodesia (Mr. J. E. Mitchell, B.Sc.Tech., M.I.E.E., M.I.Mech.E.), again draws attention to the effect of the shortage of capital on the development of the undertaking. Previously he had stated: "There appears to be some flaw in a policy of providing funds for generation work if, when such works are completed, no means of distributing the power are available because of cuts in capital distribution expenditure." In the current report (for 1955-56) he says that new extensions, etc., were completely stopped at the end of May owing to shortage of capital. Even so, the number of new consumers connected during the year—2,951—set up a new record.

The financial position was aggravated by the lack of control in the development of new townships. Thus out of over 5,500 sites available for sale, applications for connection had been received in respect of only 136. To supply these, over twelve times the amount of capital had to be invested than if the 136 consumers had been concentrated in one area.

On the technical side Mr. Mitchell reports improved efficiency by the adoption of modern techniques. For example, in May the Mayor of Salisbury formally commissioned the first gas-filled cable to be laid in the Federation. Work has also progressed on a supervisory indication and remote control system which will speed up supply after major interruptions.

Uganda Board Buys Hydro-Electric Station

The Uganda Electricity Board has purchased a small hydro-electric station near Kikagati on the Kagera River, the boundary between Uganda and Tanganyika. The station will provide electricity for Mbarara and for a mine in Tanganyika. An agreement has been concluded with the mining syndicate who will run their own transmission line from the power station to the mine. The Board is to construct a 33 kV line from the station to Mbarara when arrangements for the provision of capital are completed. These arrangements, the supply of material from the United Kingdom and the construction of the line are expected to take about two years.

The Kikagati power station was built in 1935 for the nearby Kagera Mine, now closed, and stands on the left bank of the Kagera River. One 750 kW generator is installed and there is room in the existing building for a second machine having a capacity of at least 500 kW; this second machine is likely to be required within the next few years. The consulting engineers, Sir Alexander Gibb & Partners and Messrs. Kennedy & Donkin, are supervising the work of overhauling the hydro-electric scheme and obtaining the maximum output from it.

Lake Manapouri, New Zealand, where a 1,000 MW hydro-electric development is under consideration

£100 Million New Zealand Water Power Scheme

A correspondent tells us that a scheme for hydro-electric development at Lake Manapouri, which would be the largest ever undertaken in New Zealand, is likely to become a controversial issue if the Government decides to proceed with it. An outline of the project was recently given to South Islanders by Mr. A. E. Davenport, general manager of the State Hydro-Electric Department. It would cost in the region of £100 million and would involve raising the level of Lake Manapouri by 100ft. This would be done by building a large dam across the outlet through which the Waiau River flows to the sea. Thus blocked, the lake would rise until it linked with Lake Te Anau, the second biggest in New Zealand, which lies a few miles to the north and is 90ft higher than Lake Manapouri. Te Anau would also be raised a few feet but this would not affect the township on its southern shores. Once linked, the snowfed lakes would provide a great volume of water, certainly more than enough for the one million kW that the power station would produce.

The power house would be 600ft underground at the head of Lake Manapouri. The scheme would be a valuable asset economically but much of Lake Manapouri's charm would be lost.

Financial Section

STOCKS and SHARES

NEWS of the drop of about five million in the profits reported by Associated Electrical Industries for 1956 failed to throw the market in electrical equipment shares at all seriously out of its stride. Share prices lost some of their recent gains, but most of the net changes over the past week were nevertheless for the better. The effects of last year's contraction in profit margins have been widely recognised for some time past, and in the case of A.E.I., internal reorganisation is thought to have been a factor in the results. In the gilt-edged market prices have been moving upwards again after the reactionary phase which followed last month's cut in Bank Rate.

A.E.I. Results

The A.E.I. shareholders had been warned in last September's half-yearly report that, despite a high turnover, earnings were being affected by rising costs and other factors. The past week's recession of 1s 3d in the price of the company's £1 shares, to 65s, suggests that the extent of the contraction shown by the figures in the preliminary statement of profits for the full year is rather larger than had been anticipated. At £10·3 million the group profit (before tax) is down by approximately one-third on the comparable figure for 1955. After a smaller tax charge, the net surplus is 44 per cent lower at £4·5 million. The dividend for the year is being maintained at the previous total of 15 per cent, payable on capital increased by a cash issue of shares. It involves the distribution of £2·6 million net, and is covered a little over one-and-a-half times by the surplus available.

Deccas Recover

The premium on the new Decca "A" shares, offered to shareholders at 22s 6d, recovered well from 4s 6d to 5s 6d, the old shares being 1s 3d better at 27s 6d ex-dividend. Radio shares generally maintained their momentum, Pye, Cossor, E. K. Cole, and Electric & Musical Industries all recording further advances. Plessey rose 2s 9d to 72s 3d. British Tabulating Machine were prominent again, a rise of 1s 9d to 48s 9d being connected with reports of plans for a large-scale extension of automation methods in the principal banks. London Electric Wire remained in favour, and Lucas gained ground. Despite the reaction from their best prices, several of the shares in the "atomic power" group still recorded gains on the week. English Electric, at 58s 9d, were again outstanding with a rise of 3s 6d on the strength of reports of big aircraft orders. Richardsons Westgarth were 1s better at 19s.

Morphy-Richards Progress

In declaring an interim dividend of 8 per cent (effectively the same as before) on account of the year ending next June, Morphy-Richards inform shareholders that sales at home and abroad were higher in the first six months than in the corresponding period of the previous year. Margins of profit have been maintained, and the

Price Changes in

Company or Board	Nom. Value	Middle price 4th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78½x.d.	+1	3	3	3 16 6	80	75
Brit. Elec. 1974/77	100	76½	+1	3	3	3 18 6	78½	73½
Brit. Elec. 1976/79	100	81½	+1	3½	3½	4 6 0	81½	77½
Brit. Elec. 1974/79	100	91½	+1	4½	4½	4 13 0	92½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	6 9 9†	19/-	18/3
East African Power	£1	20/-	—6d	7	7	7 0 0	20/6	19/3
Nigerian Elec.	£1	17/6		10	10*	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	14/9	+6d	10	10*	13 11 3	14/9	13/3
Equipment and Manufacturing								
Aberdare Cables	5/-	11/3	+3d	17½	17½	7 15 6	11/3	9/9
Aerialite	1/-	5/9		45	48	8 7 0	6/-	4/9
Allen, W. H.	£1	38/3		20	10*	5 4 6	39/-	25/6
Aron Elec. Ord.	£1	55/-		15	15	5 9 0	55/6	53/6
Assd. Automation	10/-	20/3		10	5	2 9 6	20/9	17/9
Assoc. Elec. Ord.	£1	65/-	—1/3	15	15	4 12 3	73/-	64/-
Automatic Tel. & El.	£1	60/-	+2/6	15	15	5 0 0	60/-	54/6
Babcock & Wilcox	£1	82/6	+1/3	15	15	3 12 9	82/6	71/6
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	4/-
Bakelite	10/-	21/3		16	16	7 10 6	21/9	20/9
Berry's Electric	5/-	5/9		—	10‡	8 14 0	5/9	5/6
British Aluminium	£1	65/-		12	12	3 13 9	70/6	63/9
B.I. Callender's	£1	49/9	—6d	10	12½	5 0 6	51/6	48/3
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	21/9	20/6
British Tabulating	£1	48/9	+1/9	9	9	3 13 9	48/9	42/-
British Thermostat	5/-	26/3		20	25	4 15 3	27/-	25/9
British Vac. Cleaner	5/-	6/6		30	15*	11 11 9	8/-	6/6
Brook Motors	10/-	32/6		25	25	7 13 9	33/3	30/-
Brush Group	5/-	6/-		10	10	8 6 9	6/3	4/6
Bulgin, A. F.	1/-	5/3	+3d	45	50	—	5/3	4/6
Burco Dean	5/-	11/3	+9d	22½	20	8 17 9	11/-	8/9
Chloride El. Storage "A"	£1	67/6		17½	17½	5 3 9	68/-	58/-
Clarke Chapman	£1	140/-		20	22½	3 4 3	7	6½
Cole, E. K.	5/-	19/6	+3d	17½	17½	4 9 9	19/6	16/6
Cossor, A. C.	5/-	6/9	+3d	15	Nil	Nil	7/3	5/9
Crabtree	10/-	25/-x.d.		20	20	8 0 0	25/6	23/3
Crompton Parkinson Ord.	5/-	16/3		16	16	4 18 6	17/9	14/6
De La Rue	5/-	18/6		30	30	8 2 3	19/9	16/3
Decca "A"	4/-	27/6x.d.	+1/3	43¾	43¾	6 7 3	32/3	27/-
Desoutter	5/-	29/6x.d.		30	32½	5 10 3	29/-	27/6
Dewhurst	2/-	7/-		30	16¼*	4 12 9	7/6	5/9
Dictograph Tel.	2/-	7/6		20	20	5 6 9	7/6	6/9
Dubilier Condenser	1/-	5/3	—3d	25	30	5 14 3	5/9	5/6
Duport	5/-	19/-		23	25	6 11 6	19/6	17/6
E.M.I.	10/-	28/3	+1/3	15	15	5 6 3	29/6	23/9
Electrical Components	5/-	7/3		25	25	8 12 6*	7/3	6/6
Elec. Construction	£1	25/-		8½	8½	6 16 0	25/6	21/9
Elliott Bros.	5/-	28/9		17½	20‡	3 9 6	29/-	26/3
Enfield Cable Ord.	£1	16/3		Nil	Nil	Nil	21/6	13/-
English Electric	£1	58/9x.d.	+3/6	12½	14	4 15 3	58/9	47/6
English Electric 3¾% Pref.	£1	13/6		3¾	3¾	5 11 0	14/3	13/3
Ericsson Tel.	5/-	40/6	+6d	20†	20†	2 9 6†	40/6	33/3
Ever Ready	5/-	30/6		35	35	5 14 9	31/9	30/-
Falk Stadelmann	£1	38/3		17½	17½	9 3 0	38/3	35/-
G.E.C. Ord.	£1	57/6x.d.	+1/9	12½	14	4 17 6	57/9	48/9
G.E.C. 6½% Pref.	£1	23/-		6½	6½	5 13 0	23/6	22/-
General Cables	5/-	12/9		30	30	11 15 3	13/6	11/6
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	46/3	45/3
Hackbridge Holdings	5/-	20/3	+6d	25	30	7 8 3	21/-	19/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	16/-	13/6
Heatrae	2/-	4/-		15	15	7 10 0	4/-	4/-
Henley's	10/-	16/6		10½	11½	6 19 6	16/6	15/3
Holophane	5/-	23/-	—9d	30	30	6 10 6	26/3	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

upward trend of business has continued into the second half of the year. With the new factory nearly ready for occupation, and an early expansion in the output of the Astral subsidiary in prospect, the way is opening for increases in production and for the introduction of new products. Benefits of these developments, for which finance was raised by the issue of convertible loan stock last December, will not be reflected in the current year's results. Last year's dividend of 50 per cent is equivalent to 20 per cent on the present capital, as increased by a scrip issue. After rising 9d to 12s 6d, the 4s ordinary shares show a yield of nearly 6¼ per cent on that basis.

Electrical Investments

Company or Board	Nom. Value	Middle price 4th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	32/6	+4/9	50	50	7 13 9	32/6	24/9
I.C.I.	£1	42/3	+1/3	10	10	4 14 9	43/9	37/9
Intl. Combustion	5/-	23/9x.d.	+6d	20	22½	4 14 9	23/9	20/-
Johnson & Phillips	£1	30/9		15	15	9 15 0	34/6	28/6
Lancashire Dynamo	£1	43/9		15	11*	5 0 6	45/-	36/9
Laurence, Scott	5/-	16/9		12½	15	4 9 6	16/9	13/9
Lister, R. A.	£1	30/-		9·3	10	6 13 3	30/6	26/9
London Elec. Wire	£1	50/6	+1/-	12½	12½	4 19 0	50/6	43/-
Lucas, J.	£1	33/9	+1/3	7½	7½	4 9 0	33/9	30/6
Marryat & Scott	2/-	8/3		30	30	7 5 6	8/6	8/-
Mather & Platt	£1	53/6x.d.		15	15	5 12 3	55/6	51/3
Metal Industries	£1	23/9		9	9	—	25/-	20/3
Midland Elec. Mfg.	£1	46/3		10	12½	5 8 0	46/3	45/-
Morphy-Richards	4/-	12/6	+9d	50	50	6 8 0*	12/6	11/9
Murex	£1	70/6	+6d	20	20	5 13 6	71/6	65/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/6	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	2/6	2/3
Parnall (Yate)	5/-	8/-		14	12	7 10 0	8/-	5/9
Parsons, C. A.	£1	65/9	+2/-	10	10	—	65/9	50/6
Plessey	10/-	72/3	+2/9	27½	30	4 3 0	72/3	61/-
Pye "A" Deferred	5/-	18/3	+3d	12½	12½	3 8 6	18/3	15/9
Reyrolle	£1	107/6	+2/3	15	16½	3 0 6	107/6	90/-
Rheostatic	4/-	10/-		18½	12‡	4 16 0	10/-	8/9
Richardsons Westgarth	5/-	19/-	+1/-	16⅝	16⅝	4 7 9	19/-	17/-
Scottish Cables	4/-	19/3	+6d	27½	27½	5 14 3	19/3	15/-
Smith (England), S.	4/-	14/6	+3d	17½	17½	4 16 6	14/6	13/-
Southern Areas	£1	17/6		10	7½	8 11 6	20/-	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/-	7/6
Sturtevant	5/-	25/6	+6d	14·4†	15†	2 18 9	25/6	24/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	15/3		20	25	8 4 0	15/6	13/6
Taylor Tunnicliff	5/-	13/3		15	15	5 13 3	13/9	11/9
T.C.C.	10/-	38/9		25	25	6 9 0	38/9	35/-
T.C. & M.	£1	31/-		8½	8½	5 9 9	31/-	24/6
Telephone Mfg.	5/-	7/-		10	10*	7 2 9	7/-	6/3
Thorn Elec.	5/-	18/9		15	15	4 0 0	19/6	16/3
Thornycroft	£1	34/6	+1/3	15	12½	7 5 0	34/6	32/9
Tube Investments	£1	58/9		22½	15*‡	5 2 3	62/-	58/3
Vactric	5/-	15/-		15	17½*	5 16 9	15/-	12/9
Veritys	5/-	9/3		12½	12½	6 15 3	9/3	8/9
Walsall Conduits	4/-	13/3	+3d	70	20*	6 0 9	13/3	11/-
Ward & Goldstone	5/-	41/3		30	35	4 4 9	41/3	36/9
Watford	2/-	6/6		25	25	7 13 9	6/6	6/3
Westinghouse	£1	80/-		18	18	4 10 0	82/6	72/-
West, Allen	5/-	13/9		15	15	5 9 0	14/3	12/3
Wolf Electric	5/-	17/6		20	20	5 14 3	18/-	17/3
Trusts, Transport and Communications								
Anglo-Portuguese	£1	23/3		8	8	6 17 9	23/3	20/6
Brit. Elec. Traction: Def. Ord. "A"	5/-	20/6	+6d	22½	22½	5 9 9	20/9	17/-
Cable & Wireless: Ord.	5/-	12/-	+9d	10	10	4 3 3	11/9	9/6
4% Loan	100	92½	+1	4	4	4 6 6	92½	89
Calcutta Trams	£1	25/9		7½†	8½†	6 12 0†	26/6	22/9
Cape Elec. Trams	£1	15/6		8	8	10 6 6	15/9	14/6
Marconi Marine	£1	33/-x.d.		10	10	6 1 3	33/6	31/-
Oriental Tel. Ord.	1/-	77/6		16	—	—	77/6	66/6
Telephone Rentals	5/-	11/-		12½	12½	5 13 9	11/3	10/3

Hoover Earnings

In view of the effect of hire-purchase and other restrictions on business in household appliances, expectations of the Hoover results for 1956 had been prepared for something larger than the drop of a million now reported by the company in its preliminary profits statement. Half way through the year the comparison with corresponding 1955 figures had been much more unfavourable, so that the second six months evidently saw an upturn of considerable substance. With a net surplus of £1·16 million, the company is able quite comfortably to maintain the dividend at a total of 50 per cent, as before. Satisfaction with this outcome to a difficult year was marked by a rise of 4s 9d to 32s 6d in the price of the 5s ordinary shares (the "A" shares being 31s 3d). The yield comes down to about 7¾ per cent.

R. B. Pullin Issues

The 2s shares of R. B. Pullin have been well supported, up to about 7s 6d, since the announcement of the latest annual results and of the intention to raise fresh capital. Profits of the group for the twelve months to September improved (excluding special credits) to £152,000, and the dividend of 20 per cent is covered some three times over by the net surplus after tax. Referring in the report to the prospect of cuts in defence expenditure, the chairman believes that the products of the group are of the kind least likely to be affected, and mentions the steps taken in recent years to expand the purely commercial interests: among the latest of these is the acquisition of Aldis Brothers. To finance the development programme the company is making a private placing of £200,000 notes and an offer of new shares to existing holders, by way of rights, at 5s per share. Allotment letters are to be posted after the annual meeting on 21st March.

Company News

Taylor Tunnicliff (Electrical Industries) 5s shares were unchanged at 13s 3d after the declaration of the single dividend for 1956, which is at the same rate (15 per cent) as was paid on the two previous occasions. The distribution again has the best part of threefold cover by net earnings which, after an increase of £16,000 in the tax provision, come out slightly lower than before at £159,000. There is a yield of nearly 5¾ per cent on the shares. Sydney S. Bird 4s shares reacted well to the company's decision to raise the dividend from 15 to 20 per cent and to the proposal, subject to official consent, of a 25 per cent scrip issue. After being marked up 1s to 8s, the shares show a yield of 10 per cent at the new dividend rate.

REPORTS and DIVIDENDS

Associated Electrical Industries, Ltd., in a preliminary statement, reports a trading profit for 1956 of £10,307,614, as compared with £15,320,780 for 1955. Taxation requires £5,847,901 (against £7,370,653), and the net profit is £4,459,713 (£7,950,127). To this is added £19,319 set aside for taxation in previous years no longer required, and after deducting £106,707, outside shareholders' interest in net profits of subsidiaries, the balance attributable to A.E.I., Ltd., is £4,372,325, of which £290,610 is retained by subsidiaries, leaving £4,081,715 to be dealt with in the accounts of the parent company. A sum of £1,250,000 is transferred to the general reserve of the holding company and it is proposed to pay a final ordinary dividend of 7½ per cent, making with the previous quarterly dividends 15 per cent for the year (unchanged). The third quarterly dividend of 2½ per cent and the final dividend are paid on capital increased by a cash issue from £25 million to £33·5 million. A further £139,483 of ordinary stock issued in December last in part exchange for 4 per cent redeemable cumulative preference stock in Siemens Brothers & Co., Ltd., is not entitled to the final dividend. The balance carried forward is £819,577 (against £748,866 brought in).

Richard Johnson & Nephew, Ltd.—At an extraordinary general meeting to be held on 15th March resolutions will be submitted increasing the authorised share capital to £3,900,000, capitalising £1,800,000 undivided profits and appropriating this sum to ordinary shareholders by paying up in full 1,800,000 unissued ordinary shares of £1 each to be distributed credited as fully paid up in the proportion of one new share for each share held. The directors recommend this capitalisation in order to bring the issued share capital more closely into line with the resources employed in the business. Consent of the Treasury has been obtained.

Bruce Peebles & Co., Ltd., report that after charging £196,000 for taxation, the profit, before depreciation of £39,600, is £185,558 for 1956, as compared with £247,498 for 1955. General reserve receives £100,000 and it is proposed to maintain the ordinary dividend for the year at 25 per cent. The 7½ preference capital receives a participating dividend of 2½ per cent, again making 10 per cent for the year.

Hoover, Ltd.—The group profits for 1956 (subject to audit) amounted to £2,790,077, as compared with £3,838,233 for the preceding year. United Kingdom taxation absorbed £1,335,266, leaving a group net profit of £1,225,082 (against £2,005,069), of which £1,163,659 is attributable to the parent company. It is proposed to pay a final dividend of 40 per cent, again making 50 per cent for the year.

George Cohen 600 Group, Ltd.—It is proposed to raise £2,000,000 by the placing of a new class of preference capital and a rights issue of ordinary shares. The proposals include the creation of 1½ million 6½ per cent £1 second cumulative preference shares and 6,000,000 5s ordinary shares. One million of the preference capital will be placed and approximately £1,000,000 will be raised by an ordinary share issue by way of rights to ordinary shareholders. The proposals will be submitted to an extraordinary meeting to be held on 26th March.

Thomas Bolton & Sons, Ltd.—The trading profit for 1956 amounts to £449,114, as compared with £476,809 for the preceding year, and after providing £70,638 (£278,541) for taxation, the net profit is £260,348 (against £85,849). It is stated that the disproportionately low charge for taxation in relation to the published profit is accounted for by the different methods of the company and the Inland Revenue, respectively, of valuing base stock. It is proposed to pay a final dividend of 7½ per cent and a bonus of 2½ per cent, maintaining the distribution for the year at 12½ per cent.

Waygood-Otis, Ltd.—The accounts for 1956 show a profit of £318,978, as compared with £492,628 for the preceding year, to which is added £27,211, adjustments from previous years. Taxation requires £135,883. It is proposed to pay a final dividend of 15 per cent (against 14 per cent), making 30 per cent for the year. For the previous year the total distribution was 54 per cent, but the interim dividend was paid on smaller capital. The balance carried forward is £293,939 (against £208,695 brought in).

Morphy-Richards, Ltd., has declared an interim dividend of 8 per cent on capital increased by a 150 per cent scrip issue. The interim dividend for the previous year on the smaller capital was 20 per cent.

Sydney S. Bird & Sons, Ltd., report a group net profit for 1956 of £87,804, as compared with £87,763 for 1955, after deducting £82,163 for taxation. It is proposed to pay a dividend for the year of 20 per cent (against 15 per cent). Subject to the consent of the Capital Issue Committee it is proposed to make a scrip issue of one-for-four.

Taylor, Tunnicliff (Electrical Industries), Ltd., reports that after providing £198,955 for taxation (against £182,849), the consolidated net profit for 1956 is £159,020 (against £163,809 for 1955). The dividend for the year is unchanged at 15 per cent.

New Companies

Nuclear Controllers, Ltd.—Registered 14th February. Capital £100. To design, develop and carry on the business of manufacturers of and dealers in equipment for controlling nuclear reactors for electrical power generators and marine propulsion, etc. Solicitors: Wright & Bull, 25, Old Buildings, Lincolns Inn, London, W.C.2.

Tungstalite (Sales), Ltd.—Registered 20th February. Capital £10,000. Manufacturers of and dealers in electric lamps, electrical machinery, etc. Solicitors: Asher Fishman & Co., 12, Devonshire Row, E.C.2.

Long and Watson, Ltd.—Registered 20th February. Capital £3,000. Manufacturers of and dealers in radio and television sets, accessories and apparatus, etc. S. G. Watson is the first director. Regd. office: 291a, Northborough Road, S.W.16.

Printed Electronic Components, Ltd.—Registered 8th February. Capital £100. Manufacturers of electronic components, printed circuits, electronic engineers, etc. Directors: Edith G. Goodwin and Cecilia M. Shannons. Regd. office: Alert Works, 27, Willowbrook Road, Peckham, S.E.15.

Jackson Electrical Co. (Eastbourne), Ltd.—Registered 6th February. Capital £2,000. Electrical engineers and general electrical installation contractors, radio and television engineers, etc. Directors: H. L. Jackson, E. G. Turner and W. J. Clarke. Regd. office: 21, Gildredge Road, Eastbourne.

E. R. Bullimore & Son, Ltd.—Registered 6th February. Capital £1,000. Manufacturers of and dealers in domestic electrical appliances, etc. Directors. E. R. Bullimore, P. R. L. Bullimore and Dorothy Z. Bullimore. Regd. office: 81, Newton Nottage Road, Porthcawl, Glam.

Power Development, Ltd.—Registered 6th February. Capital £20,000. Electrical, mechanical and consulting engineers and contractors, etc. Regd. office: EMP Electric Factory, Garman Road, N.17.

R. E. Howard & Son (Electrical Contractors), Ltd.—Registered 31st January. Capital £100. Directors: R. E. Howard and Mrs. Dorothy B. Howard. Regd. office: Hascombe, Brooklyn Road, Woking, Surrey.

Techna (Sales), Ltd.—Registered 31st January. Capital £100. Manufacturers, engineers and contractors in electrical and mechanical goods of all kinds, etc. Directors: E. Mestitz and Rosina Mestitz. Regd. office: 47, Whitehall, S.W.1.

R. & D. Kosmin, Ltd.—Registered 4th February. Capital £1,000. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: R. N. Kosmin, Doris Kosmin and R. R. Green. Regd. office: 120, Baker Street, W.1.

Mec-Test, Ltd.—Registered 4th February. Capital £100. Electronic and automation engineers, etc. Directors: J. H. D. Walton and R. H. Stocken. Regd. office: Eagle House, 109, Jermyn Street, S.W.1.

Citaco (1957), Ltd.—Registered 11th February. Capital £1,000. Manufacturers of and dealers in radio, electrical and mechanical apparatus of all kinds, etc. Regd. office: 33, Brewer Street, W.1.

Nuvac Electronic, Ltd.—Registered 25th February. Capital £100. Manufacturers of and dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: R. L. Smith and Mrs. Elsie F. Smith. Regd. office: Imperial Way, Balmoral Road, Watford.

P. O'Connell, Ltd.—Registered 12th February. Capital £1,000. Electrical engineers, etc. Directors: P. O'Connell and Mrs. Ella E. O'Connell. Regd. office: 1, Wilson Road, Reading.

Metrix Instruments, Ltd.—Registered 18th February. Capital £1,000. Electronic, mechanical, electrical and general engineers, etc. Regd. office: Fairfax House, Fulwood Place, High Holborn, W.C.1.

W. Robb (Cheltenham), Ltd.—Registered 18th February. Capital £4,000. To acquire the business of an electrical engineer and

dealer in electrical appliances carried on by H. A. Crawford at 30, Suffolk Parade and 11-12, Winchcombe Street, Cheltenham, as W. Robb, etc. Directors: H. A. Crawford and Mrs. Janet Crawford. Regd. office: 30, Suffolk Parade, Cheltenham.

Increases of Capital

Electro Dynamic Construction Co., Ltd.—Increased by £180,000, in £1 ordinary shares, beyond the registered capital of £35,000.

Milliwatt, Ltd.—Increased by £10,000 in £1 ordinary shares, beyond the registered capital of £5,000.

Liquidations

Hornby Electrical Supplies Co., Ltd. and **Robert Hornby & Co., Ltd.**—Members' voluntary winding-up. Liquidator, Mr. J. J. S. Herd, 15, Anerley Park, London, S.E.20, appointed 12th February. Particulars of claims to the liquidator by 27th March.

D.R.P., Ltd., manufacturers of telephonic equipment.—Members' voluntary winding-up. Liquidator, Mr. B. L. Hughes, 4, Moorgate, London, E.C.2, appointed 15th February.

Electricians, Ltd.—Winding up voluntarily. Liquidator, Mr. S. O. Henry, Parkin S. Booth & Co., 5, Rumford Place, Liverpool, 3, appointed 21st February. Particulars of claims to the liquidator by 21st March.

Bulwell Electric & Radio, Ltd.—Winding up voluntarily. Liquidator, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3.

Newports Electrics (Southampton), Ltd.—In creditors' voluntary liquidation. Particulars of claims to the liquidator, Mr. N. Osborne, 11-12, Finsbury Square, London, E.C.2, by 14th March.

Bankruptcies

A. E. R. Honey, 48, Bramerton Road, Beckenham, Kent, electrical contractor, lately carrying on business at that address and at 117, Anerley Road, Penge, Kent.—Receiving order made 14th February on debtor's own petition.

G. W. Altass, 1, Bruce Avenue, Shepperton, Middx., formerly residing at 16, St. Philip's Avenue, Worcester Park, electrical engineer and general contractor.—First dividend of 4s. in the £, payable on and after 20th March at 2-3, Norfolk Street, London, W.C.2.

H. M. Pollen, residing at 22, Riverside Close, Staines, Middx., lately carrying on business as a radio and electrical engineer under the style of Thameside Electrical Services, at 51, Thames Side, Staines.—First and final dividend of 2d in the £, payable at 11-12, Finsbury Square, London, E.C.2.

G. A. Adams, 51, Hollyfaste Road, Sheldon, Birmingham, previously carrying on business, at first in partnership with another, at 90, Jamaica Row, Birmingham, and latterly from 1, Ings Road, Wombwell, East Riding, Yorks, as "Electro-Neon Lighting Co.", electrical contractor.—Public examination 10th April at the Court House, Corporation Street, Birmingham, 4.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 13th March from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

32286. Standard Telephones & Cables, Ltd.—Railway route-setting apparatus. 19th December, 1952. (Addition to 767941.) (769683.)

1953

9208. Philips Electrical Industries, Ltd.—Electric circuits and discharge-tubes for storing and transmitting elements of information. 2nd April, 1953. (770047.)

15085. Standard Telephones & Cables, Ltd. (Bell Telephone Manufacturing Co., Soc. Anon.).—Electrical connecting circuits. 21st May, 1954. (769915.)

35126. Automatic Telephone & Electric Co., Ltd.—Electromagnetic relays. 22nd September, 1954. (770030.)

1954

992. Cinema-Television, Ltd.—Electrical calculating apparatus. 11th January, 1955. (770034.)

5605. Associated Electrical Industries, Ltd.—Transparent conducting films on transparent insulating backings. 26th November, 1954. (769697.)

5951. Metropolitan-Vickers Electrical Co., Ltd.—Control equipment for electric motors. 25th February, 1955. (Addition to 728459.) (769564.)

6922. Electric & Musical Industries, Ltd.—Electron-discharge tube arrangements. 10th March, 1955. (770054.)

6965. Cinema-Television, Ltd.—Thermionic valve signal selecting circuits. 10th March, 1955. (769698.)

7808. Westinghouse Brake & Signal Co., Ltd., Peter, L. H., and Walker, A. H. B.—Dry plate rectifier assemblies. 14th February, 1955. (769701.)

7887. National Research Development Corporation.—Semi-conductor devices. 25th February, 1955. (Cognate application 21537, 23rd July, 1954.) (769702.)

7910. Pye, Ltd.—Radio-frequency valve amplifiers. 3rd June, 1955. (770055.)

9426. Stern, W. L.—Power factor regulators. 14th June, 1955. (769703.)

10265. National Research Development Corporation.—Gate circuits embodying transistors. 4th April, 1955. (770056.)

11168. United Kingdom Atomic Energy Authority.—Electrical pulse scaling circuits. 15th April, 1955. (769704.)

12595. English Electric Co., Ltd.—Cathode-ray oscilloscope time-base signal generating circuits. 29th April, 1955. (770013.)

21143. Metropolitan-Vickers Electrical Co., Ltd.—H.v. isolator switches. 11th July, 1955. (769579.)

22831. British Dielectric Research, Ltd.—Electric capacitors. 5th August, 1955. (769794.)

23929. Murex, Ltd.—Moving coil electrical instrument. 25th July, 1955. (769796.)

24718. General Electric Co., Ltd.—Electric glow discharge switches. 17th August, 1955. (769797.)

24742. Measuring Instruments (Pullin), Ltd.—Electrical measuring instruments. 25th August, 1955. (769798.)

25392. Cathodeon, Ltd.—Glass-to-metal seals. 31st August, 1955. (770107.)

26474. Westinghouse Brake & Signal Co., Ltd., and Walker, A. H. B.—Manufacture of dry rectifiers. 22nd June, 1955. (769715.)

27146. Mullard Radio Valve Co., Ltd.—Means for compensating transistor circuit arrangements in relation to external conditions. 19th July, 1955. (769584.)

30283. Siemens-Schuckertwerke Akt.-Ges.—Semi-conductor devices having variable electric characteristics. 20th October, 1954. (Addition to 750134.) (770066.)

30873. British Thomson-Houston Co., Ltd.—Machines for use in manufacturing caps for incandescent lamps. 26th October, 1954. (770042.)

30874. British Thomson-Houston Co., Ltd.—Bases for electrical incandescent lamps. 26th October, 1954. (770043.)

31090. Electric & Musical Industries, Ltd.—Relay systems. 28th October, 1955. (769591.)

31493. Radio Corporation of America.—Message comparator. 1st November, 1954. (769909.)

32432. Crompton Parkinson, Ltd.—Electric arc stud welding. 9th November, 1955. (769596.)

33179. General Electric Co.—Electric hot plates. 16th November, 1954. (770111.)

33460. British Thomson-Houston Co., Ltd.—Wire drawing. 25th October, 1955. (769723.)

34813. Philips Electrical Industries, Ltd.—Transistor circuits for controlling electric loads. 1st December, 1954. (770068.)

35454. Radio Corporation of America.—Travelling-wave tube. 7th December, 1954. (769724.)

36936. General Electric Co.—Digital calculating apparatus. 21st December, 1954. (769726.)

37609. Libbey-Owens-Ford Glass Co.—Light transmission electrically conducting article. 30th December, 1954. (770069.)

1955

2218. General Electric Co.—Means for transforming the phases in electric power systems. 25th January, 1955. (769731.)

4628. Goldberg, J., Cox, B., and Heywood, J. E.—Electrical apparatus for sorting signals. 16th February, 1955. (769908.)

4785. British Insulated Callender's Cables, Ltd.—Electric cables. 16th February, 1956. (Cognate application 18213, 23rd June, 1955.) (769610.)

6231. English Electric Co., Ltd.—Gas-tight seals between a metal and an insulating material. 28th February, 1956. (769935.)

6992. Telefonaktiebolaget L. M. Ericsson.—Multi-channel pulse two-wire communication exchange systems. 9th March, 1955. (769734.)

7580. Raytheon Manufacturing Co.—Electromagnetic cooking apparatus and methods for employing same. 15th March, 1955. (770076.)

7851. General Electric Co.—Electric clocks. 17th March, 1955. (769614.)

8346. Radio Corporation of America.—Information selecting circuits. 22nd March, 1955. (769910.)

8857. Standard Telephones & Cables, Ltd.—Method and apparatus for the production of films having a plurality of components. 25th March, 1955. (770077.)

9537. Standard Telephones & Cables, Ltd.—Electronic registering equipment. 1st April, 1955. (769617.)

9607. Landis & Gyr Akt.-Ges.—Multiple tariff counting mechanism for electricity meters. 1st April, 1955. (769619.)

9763. Philips Electrical Industries, Ltd.—Wire coils having a displaceable tapping, more particularly for variable inductors. 4th April, 1955. (769940.)

10194. Protona Produktionsges. für Elektro-Akustische Geraete Ges.—Electro-acoustical apparatus magnetic tape spool arrangement. 7th April, 1955. (769944.)

10523. Welwyn Electrical Laboratories, Ltd., and Whitfield, E. H.—Electrical resistors. 12th April, 1955. (770081.)

10641. Sperry Corporation.—Microwave attenuators and methods of their manufacture and travelling-wave tubes incorporating such attenuators. 13th April, 1955. (770083.)

[Continued on next page

NEW PATENTS (*continued*)

10784. Felbert, N.—Electric bakery ovens. 14th April, 1955. (770118.)

11104. Chromatic Television Laboratories, Inc.—Cathode-ray tubes for use in reproducing colour television pictures. 18th April, 1955. (769744.)

11220. Ericsson Telephones, Ltd., and Distin, L. S.—Electromagnetic relays. 19th April, 1955. (769949.)

11317. Sylvania Electric Products, Inc.—Thermal insulation for cathode. 19th April, 1955. (770086.) 11320. Electrode supports for electron discharge tubes. 19th April, 1955. (769951.)

11576. British Thomson-Houston Co., Ltd.—Operation of dynamo-electric machines in mutual synchronism. 21st April, 1955. (Addition to 764899.) (769746.)

11600. Siemens-Schuckertwerke Akt.-Ges.—Electric surge arrestors. 21st April, 1955. (769956.)

12010. Compagnie Générale de Télégraphie sans Fil.—Ultra-high-frequency oscillators. 26th April, 1955. (769959.)

12168. Fkg F. Kesselring Geratebau Akt.-Ges.—Arrangements for limiting overload currents. 27th April, 1955. (Addition to 748532.) (769752.)

12419. Etablissements Merlin & Gerin.—Air-blast circuit-breaker with multiple arc-extinction chambers. 29th April, 1955. (769970.)

13086. General Electric Co.—Methods of assembling refrigeration systems. 5th May, 1955. (769964.)

13342. Philips Electrical Industries, Ltd.—Methods of producing selenium rectifier plates. 9th May, 1955. (769811.)

13896. Mullard Radio Valve Co., Ltd.—Electrical power supplies. 13th May, 1955. (Addition to 708169.) (769815.)

13923. General Electric Co.—Electric tracer heads. 13th May, 1955. (769978.)

14080. Bendix Aviation Corporation.—Electromagnetic pump. 16th May, 1955. (770126.)

14314. Allmanna Svenska Elektriska Aktiebolaget.—Means for cooling electrical windings. 18th May, 1955. (769762.)

14524. Hartig, F.—Air-break electric isolating switches. 20th May, 1955. (769819.)

14810. Institut Textile de France.—Discharge of static electricity from fabrics and other dielectric materials. 23rd May, 1955. (769769.)

14824. Allard, G.—Automatic circuit-breakers. 23rd May, 1955. (769657.)

14863. Standard Telephones & Cables, Ltd.—Light current electromagnetic contact making relays. 23rd May, 1955. (769770.)

14964. Daimler-Benz Akt.-Ges.—Electrical measuring apparatus using inductive responsive devices. 24th May, 1955. (769774.)

14979. General Electric Co.—Electrically insulated conductors. 24th May, 1955. (769662.)

15005. Natal, A.—Electric room and boiler heater. 15th June, 1955. (769663.)

15369. Westinghouse Air Brake Co.—Polarised electromagnetic relays. 27th May, 1955. (769778.)

15432. Standard Telephones & Cables, Ltd.—Multiplexing arrangements. 27th May, 1955. (769668.)

15647. Temme, W. F. J. F.—Electric terminals for connecting to poles. 31st May, 1955. (769670.)

15812. General Electric Co.—Method and apparatus for loading flash lamps. 2nd June, 1955. (769780.)

15863. Muirhead & Co., Ltd.—Angular position testing means for electrical instruments. 2nd June, 1955. (769830.)

15913. Allmanna Svenska Elektriska Aktiebolaget.—Arrangement in air-blast circuit-breakers. 3rd June, 1955. (770099.) 15914. High voltage air-blast circuit-breaker. 3rd June, 1955. (769831.) 15915. Operating device for air-blast circuit-breakers. 3rd June, 1955. (770100.) 15916. Polyphase air-blast circuit-breaker. 3rd June, 1955. (769832.) 15917. Extinguishing chamber for oil-blast circuit-breakers. 3rd June, 1955. (769781.) 15919. Diverter protection system in current converters for high voltage d.c. 3rd June, 1955. (769782.)

16006. Siemens & Halske Akt.-Ges.—High frequency electric coaxial and symmetrical plane cables. 3rd June, 1955. (769783.)

16030. Compagnie Générale de Télégraphie sans Fil.—Permanent magnets. 3rd June, 1955. (770133.)

16031. Accumulatoren-Fabrik Akt.-Ges.—Electric accumulators. 3rd June, 1955. (769784.)

16034. General Electric Co.—Refrigerators. 3rd June, 1955. (770134.)

16205. General Electric Co.—Resilient mounting of machines having rotatable parts. 6th June, 1955. (770102.)

16345. Philips Electrical Industries, Ltd.—Electrical transformers. 7th June, 1955. (769840.)

16780. Accumulatoren-Fabrik Akt.-Ges.—Dry sulphuric acid electrolytes for electrical lead accumulators. 10th June, 1955. (769850.)

17175. Singer Manufacturing Co.—Electric power transmitter. 15th June, 1955. (770137.)

17193. Imperial Chemical Industries, Ltd.—Arc melting furnaces. 15th June. 1955. (769856.)

17345. Aktiebolaget Svenska Flaktfabriken.—Method of cleaning the electrodes in electrical precipitators. 16th June, 1955. (769865.)

17543. Northrop Aircraft, Inc.—Electrical step-by-step motor. 17th June, 1955. (769872.)

17878. Howden & Co., Ltd., J.—Automatic control of electrostatic precipitators. 21st June, 1955. (769880.)

17896. Westinghouse Electric International Co.—Current collecting means for dynamo-electric machines. 21st June, 1955. (769882.)

17926. Reyrolle & Co., Ltd., A.—Bushing insulators for electrical apparatus. 21st June, 1955. (Addition to 733044.) (769884.)

18345. Standard Telephones & Cables, Ltd.—Methods and apparatus for testing radio equipment having suppressed aerials. 24th June, 1955. (769891.)

18611. Wörner, A., and Ersing, M. (trading as Kautt & Bux).—Moulded commutator. 28th June, 1955. (769896.)

18631. Contraves Akt.-Ges.—Device for the conversion of an electrical magnitude into a corresponding mechanical movement of translation. 28th June, 1955. (769899.)

18935. Foster Wheeler, Ltd.—Water tube boilers. 30th June, 1955. (769905.)

35406. Westinghouse Electric International Co.—Electromagnetic devices. 9th December, 1955. (769907.)

1956

10302. Cinema Television, Ltd.—Apparatus for the evaluation of low frequencies. 11th January, 1955. (Divided out of 770034.) (770035.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 20th March:—

No. 754,911 (design). Class 9. Radio apparatus.—Jewel Radio, Ltd., "Tuskite Works," Marsh Road, Pitsea, Basildon, Essex.

DATATRON. No. 757,426. Class 9. Electronic machines for processing data.—Burroughs Corporation, Detroit, U.S.A. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

PORTAVOX. No. 756,992. Class 9. Telephone apparatus and sound amplifiers.—British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.

PYROCO. No. 758,903. Class 9. Electrical measuring instruments, experimental furnaces and thermometers. PYROCO. No. 758,904. Class 11. Electric furnaces (not for experimental purposes).—H. Elliss, trading as Pyrometric Equipment Co., Unity Works, 49, High Street, Market Harborough, Leics.

WRICAST. No. 759,067. Class 9. Electrical and electronic apparatus; radio apparatus; and parts.—Alexander Wright & Co., Ltd., 1, Westminster Palace Gardens, Artillery Row, Victoria Street, London, S.W.1.

CADWELD. No. 759,230. Class 9. Electrical connections.—Erico Products, Inc., Cleveland, Ohio, U.S.A. Address for service, c/o D. Young & Co., 10, Staple Inn, London, W.C.1.

WINCHAFF. No. 759,751. Class 9. Electrical apparatus and instruments; radio, measuring and signalling apparatus; and parts and fittings.—Chemring, Ltd., Kangley Bridge Road, Lower Sydenham, London, S.E.25.

CUB. No. 760,327. JUNO. No. 760,328. Class 9. Radio receiving apparatus.—Teledictor, Ltd., 214, Birmingham Road, Dudley, Worcs.

PYECO. No. B741,060. Class 11. Domestic electrical appliances and parts.—Pye, Ltd., Radio Works, St. Andrews Road, Cambridge.

PYROFLECTOR. No. 758,554. Class 11. Electric heating apparatus and appliances and parts.—British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.

CATALOGUES AND LISTS

ACTUATOR.—8-page brochure describing the type 291 industrial actuator equipment.—**English Electric Co., Ltd.,** Stafford.

BOILER CONTROL.—Leaflets (111 and 112) dealing with automatic control equipment for oil-fired boilers and furnaces.—**James Gordon & Co., Ltd.,** Dalston Gardens, Stanmore, Middlesex.

BUSBAR CHAMBERS.—Leaflets B4/1/56 illustrating busbar chambers, switchboards and link boxes, and B4/2/56 covering general purpose boxes and instrument and switch panels.—**Davis Sheet Metal Engineering Co., Ltd.,** Eley's Estate, Angel Road, Edmonton, London, N.18.

CONDUIT FITTINGS.—20-page catalogue giving prices and particulars of the range of "Newall" adjustable girder clips and a separate list describing the company's "Fastclamp" adjustable I-beam and angle beam clamps designed for use with Canadian and U.S.A. conduits.—**Evans & Newall, Ltd.,** Moor Top Works, Heaton Moor, Stockport, Cheshire.

LIGHTING FITTINGS.—Leaflet giving particulars of the "Gaylite" adjustable clip-on shades for "Maxtrip 2" lamp fittings, together with a folder describing the SA range of lighting fittings and including samples of the plastic laminated fabric used for the shades.—**Linolite, Ltd.,** 118, Baker Street, London, W.1.

PLUGS AND SOCKETS.—41-page catalogue listing a range of soldered and solderless types of aluminium Mk. 4 plugs and sockets with ratings up to 60 A.—**Plessey Co., Ltd.,** Ilford, Essex.

PUMPS.—Illustrated leaflet (164) giving particulars of electrically driven three-throw high-pressure reciprocating pumps for boiler feeding and re-circulating, chemical injection, oil pressure, hydraulic plant and similar duties.—**G. & J. Weir, Ltd.,** Cathcart, Glasgow, S.4.

SMOKE DETECTION. — Leaflet (CW 3667) dealing with the company's smoke meter and alarm equipment.—**A. M. Lock & Co., Ltd.,** 79, Union Street, Oldham, Lancs.

SWITCHGEAR. — Illustrated brochure (SG/337) describing the company's OB3, OB4 and OB5 range of medium voltage air-break circuit-breakers.—**English Electric Co., Ltd.,** Switchgear Department, East Lancashire Road, Liverpool, 10.

TRANSFORMERS.—Catalogue (SG/238) giving particulars of type FMJ oil-filled outdoor current transformers and a leaflet (SG/240) describing the FMB indoor bar primary dry type current transformers.—**English Electric Co., Ltd.,** Stafford.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 11th March

BIRMINGHAM. — Imperial Hotel, 6 p.m. I.E.E. South Midland Supply & Utilisation Group. "Age and the Incidence of Fires in Electrical Installations," by L. Gosland.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "Transistor Power Amplifiers," by R. A. Hilbourne and D. D. Jones, and "Transistor D.C. Convertors," by L. H. Light and P. M. Hooker.

University College, 6.30 p.m. Royal Statistical Society, South Wales Group. "Electronic Computers for Industrial Statistical Problems," by D. G. Owen.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Simple Approaches to the Understanding of Commutation," opened by Prof. A. Tustin.

1, Birdcage Walk, S.W.1, 6.30 p.m. I.E.E. London Graduate & Student Section. "Power Resources," by Sir Josiah Eccles. (Joint meeting with the Graduate & Student Sections of the Institutions of Civil and Mechanical Engineers.)

At the Institution of Electrical Engineers, Savoy Place, W.C.2, 6 p.m. Electrical Association for Women. Caroline Haslett Trust Lecture, by Miss P. E. Grady.

MALVERN.—Winter Gardens. I.E.E. South Midland Centre, Malvern & District meeting. "Vacuum Techniques," by D. J. Taylor, "Temperature Control," by J. P. King, and "Cutting of Semi-Conductors," by J. R. Walford.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "Mechanical Strength of Power Transformers in Service," by E. T. Norris.

SHEFFIELD. — The University, Western Bank, 6.30 p.m. I.E.S. Sheffield Centre. "Light and Vision," by H. Moore.

Tuesday, 12th March

ARBORFIELD.—R.E.M.E. Training Centre, Bailleul Barracks, 7 p.m. I.E.E. Graduate & Student Section, district meeting. "The Gyroscope," by Dr. H. W. Thomas.

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

BRISTOL.—Royal Hotel, 3 p.m. I.E.S. Bath & Bristol Centre. "A Critical Analysis of Lighting Equipment and its Maintenance," by J. Mortimer Hawkins and C. J. Veness. (Joint meeting with E.C.A.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Supply Sections. "An Analogue Computer for Nuclear Power Studies," and "The Application of Analogue Methods to Compute and Predict Xenon Poisoning in a High-Flux Nuclear Reactor," by G. J. R. MacLusky. (In conjunction with the British Nuclear Energy Conference.)

21, Tothill Street, S.W.1, 6 p.m. Illuminating Engineering Society. "Visibility on the Road," by A. J. Harris.

Bonnington Hotel, Southampton Row, 6.30 p.m. Institute of Electricity Administration. "Administrative Problems of Rural Electrification," by W. E. Wardrop.

Connaught Rooms, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Speaker, Ivor Williams.

MANCHESTER.—Midland Hotel, 6.45 for 7.15 p.m. I.E.E. North-Western Centre. Annual dinner.

College of Technology, 7.30 p.m. Society of Instrument Technology, Manchester Section. "The Training of Instrument Engineers," by D. P. Lant.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Sub-Centre. "Ferrites," by Prof. F. Brailsford.

Tuesday, 12th March, to Friday, 15th March

LONDON.—Victoria Halls and Connaught Rooms. E.D.A./E.A.W. Conference of Electrical Housecraft Advisers and Demonstrators.

Wednesday, 13th March

ABERDEEN.—Caledonian Hotel, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

BIRMINGHAM.—Exchange & Engineering Centre, Stephenson Place, 7.15 p.m. A.S.E.E. Birmingham Branch. "Earth Leakage Protection in Domestic and Similar Installations," by E. Coleman.

BRADFORD.—At the Royal Infirmary, 8 p.m. A.S.E.E. Bradford Branch. "Uses of X-rays," by F. Hudson.

BRIGHTON.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "Heat Pumps," by Miriam V. Griffith.

EDINBURGH.—North British Hotel, Princes' Street, 7.30 p.m. Institution of Production Engineers, Edinburgh Section. "The Implications of Automation." (Joint meeting with South East of Scotland Branch of the Institute of Personnel Management.)

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. "Police Work," by G. F. Goodman.

LONDON. — I.E.E. London Graduate & Student Section. Visit to Lime Grove Television Studios, at 2.30 p.m.

Anatomy Theatre, University College, Gower Street, W.C.1, 7.30 p.m. Radar Association. "Radar Techniques in Science and Industry," Sir John Cockcroft.

1, Birdcage Walk, S.W.1, 6 p.m. Institution of Heating & Ventilating Engineers. "Some Design Considerations of Floor Heating," by E. Danter.

MANCHESTER. — Engineers' Club, Albert Square, 2.30 p.m. Institute of Fuel, North-Western Section. "Nuclear Power," by J. M. Bazin and R. L. Saggers.

Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio & Telecommunication Group. Radio & Telecommunication Section chairman's address, "The Electronic Age," by Dr. R. C. G. Williams.

NEWCASTLE-UPON-TYNE. — Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North Eastern Section. "Basic Waveguide Test Appliances," by R. C. Tomkinson.

NORTHAMPTON.—College of Technology, 7.15 p.m. Northampton & District Electrical Association. "High Quality Sound Reproduction," by J. Moir.

NOTTINGHAM.—Victoria Hotel, 6.30 for 7 p.m. Incorporated Plant Engineers, East Midlands Branch. Annual dinner.

OXFORD.—37, George Street, 7 p.m. I.E.E. district meeting. "Impulse Testing of Electrical Equipment for Supply Systems," by D. Wadland.

PRESTON.—19, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

SHEFFIELD.—The University, St. George's Square, 7 p.m. Society of Instrument Technology, South Yorkshire Section. Annual general meeting, followed by an address by the chairman, T. Land.

The University, 5 p.m. Institute of Physics, Yorkshire Branch. Annual general meeting, followed by "The Properties of Materials in Nuclear Reactors," by Dr. P. Murray.

STAFFORD. — Technical College, 7 p.m. I.E.E. North Staffordshire Sub-Centre. Three short papers. (Joint meeting with the Graduate & Student Section.)

Thursday, 14th March

BATH.—Technical College, 7 p.m. I.E.E. Bristol Graduate & Student Section. "Some Experiments with High Speed Engines," by R. C. Cross. (Joint meeting with the Graduate & Student Sections of the Institutions of Civil and Mechanical Engineers.)

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

KETTERING. — George Hotel, 7.30 p.m. I.E.E. East Midland Centre. "Research in Industry," by Dr. D. R. Hardy.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section. "Electrical Equipment for Rectifier Locomotives," by H. B. Calverley, E. A. Jarvis and E. Williams, and "Circuit Calculations for Rectifier Locomotives and Motor Coaches," by T. E. Calverley and D. G. Taylor.

MANCHESTER.—Engineers' Club, 6.45 p.m. Institution of Mechanical Engineers, North Western Branch. "Fast Reactors," by J. Tatlock.

SOUTHSEA.—Royal Beach Hotel, 8 p.m. A.S.E.E. Portsmouth Branch. "Co-ordination between Lighting and Interior Decoration in Industry," by R. Pye.

SWANSEA.—South Wales Electricity Board Showrooms, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie (to be read by A. A. Fulton).

Friday, 15th March

BLACKBURN.—Assembly Hall. Incorporated Plant Engineers, Blackburn Branch. Annual dinner.

EDINBURGH.—The University, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Applications of Particle Accelerators," by C. W. Miller.

HULL.—Y.E.B., Ferensway, 7 p.m. I.E.S. Leeds Centre. Annual general meeting and members' discussion.

LONDON.—Café Royal, 7 for 7.30 p.m. I.E.E. Radio and Measurement Sections. Joint dinner-dance.

Connaught Rooms, W.C.2, 6.30 for 7 p.m. Batti-Wallahs' Society. Ladies' night.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Industrial Television," by J. E. H. Brace.

Engineers' Club, Albert Square, 6.30 p.m. Institution of Heating & Ventilating Engineers, Manchester & District meeting. Annual general meeting, followed by chairman's address.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North Eastern Graduate & Student Section. "Electricity as an Aid to Coal Mining," by R. Quayle and R. Strong.

NOTTINGHAM.—Odeon Restaurant & Ballroom, Angel Row. A.S.E.E. Nottingham Branch. Annual ladies' evening buffet-dance.

Saturday, 16th March

OXFORD.—Regents Park College, Pusey Street, 6.30 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Specialised Spot Welding," by C. G. Aldridge.

STAFFORD.—Technical College, 7.15 p.m. I.E.E. North Staffs. Sub-Centre Graduate & Student Section. Conversazione.

Royal Society Soirée

At its recent meeting the Council of the Royal Society changed the date of the Society's Soirée from Thursday, 27th June, to Friday, 28th June.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia. — Victorian Railways. 27th March. Four 300 kVA transformers. (E.S.B. 5044/57. Ten/24401.)*

Belgium.—Telegraph and Telephone Administration, Brussels. Two 500 kW generating sets. (E.S.B. 5107/57. Ten/24523.)*

Formosa.—Central Trust of China, Purchasing Department. 25th March. Electric motors and control panels. (E.S.B. 4761/57. I.C.A. Ten/24351.)*

Greece.—Ministry of Finance, State Procurement Service. 27th March. Electric refrigerators. (E.S.B. 5029/57. Ten/24420.)*

Iraq.—Directorate General of Municipalities. 20th April. Two 50 kW generating sets, switchboards, etc. (E.S.B. 4883/57. Ten/24358.)*

Kent.—County Council. Street lighting equipment. (See this issue.)

Laos.—Service National de la Météorologie. 23rd March. Radio equipment. (See this issue.)

Malta.—Director of Contracts. 11th April. E.h.v. switchgear and ancillary equipment for Gozo and Comino electrical distribution scheme. (See this issue.)

New Zealand.—General Post Office. 21st March. Switchboard keys. (E.S.B. 4799/57. Ten/24422.)* 25th March. Induction coils and jacks. (E.S.B. 4796/57. Ten/24424.)* 2nd April. Switchboard cords. (E.S.B. 4935/57. Ten/24442.)*

State Hydro-Electric Department, Wellington. 3rd July. One auxiliary 625 kVA generator. (E.S.B. 5235/57. Ten/24447.)*

Pakistan.—Posts and Telegraphs Department. 13th March. Impedance measuring bridge. (E.S.B. 4856/57. Ten/24412.)*

Pakistan Industrial Development Corporation. 15th March. Machinery and plant including electric mine hoists, exhaust and auxiliary fans, electric charging equipment, etc. (E.S.B. 4775/57.I.C.A. Ten/24356.)*

Rhodesia and Nyasaland.—Educational Aids Office. 15th March. Thirty tape recorders. (E.S.B. 5158/57. Ten/24430.)*

Nyasaland Government Supplies Tender Board. 21st March. 320 lead-acid batteries. (E.S.B. 4795/57. Ten/24421.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 5th April. Refrigeration plant. (E.S.B. 5058/57. Ten/24425.)*

City of Johannesburg. 14th March. 11 kV isolating links, isolators and bushings. (E.S.B. 5252/57. Ten/24456.)*

Thornaby-on-Tees. — Borough Council. 22nd March. Street lighting equipment. (See this issue.)

Thurrock.—U.D.C. 18th March. Columns and electrical equipment for 47 group "B" street lighting units. Surveyor, Palmer's Avenue, Grays.

United States.—Public Utility District No. 1 of Chelan County, Washington. 15th March. 230 kV outdoor oil circuit-breakers. (E.S.B. 4827/57. Ten/24484.)*

Bureau of Reclamation. 21st March. 14·4 kV and 115 kV power circuit-breaker. (E.S.B. 4843/57. Ten/24492.)* 26th March. Three mobile power transformer units. (E.S.B. 4249/57. Ten/24462.)* 28th March. Three auto transformers. (E.S.B. 4842/57. Ten/24493.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Glasgow.—Education Committee. Electrical installation work at Toryglen Primary School (£4,094).—J. B. Meiklejohn.

Hartlepool.—Corporation. Electrical installations in 47 houses in the Blandford Street area (£1,322).—John Westmoreland & Co.

Newcastle-on-Tyne. — Education Committee. Electrical installation at the new Kenton Primary School (No. 2) (£5,749).—J. Robinson (Electrical)

South Shields. — Corporation. Electrical installation at the new Marine and Technical College (second instalment) (£17,358).—North of England Engineering & Electrical Co., Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Alcester.—Houses and flats (100), Conway estate; C. B. Machin, R.D.C. surveyor, Kinwarton Road Offices.

Bath.—Houses (109) and shops (6), Kingsmead; Hugh D. Roberts, architect to T.C., 30, Brock Street, Bath.

Beeston.—Home for old people (£38,000); county architect, County Hall, Trent Bridge, Nottingham.

Bourne.—Modernisation of St. Peter's Hospital, for Sheffield Regional Hospital Board; Vallance & Westwick, architects, White Hart Chambers, Mansfield.

Caernarvon.—Works, Glynllifon Park area; Ashburton Chemical Works, Ltd., Tenax Road, Trafford Park, Manchester.

Corby.—Magistrates' court house; county architect, County Hall, Northampton.

Crewe.—Secondary modern school for boys; L. Reeves, borough surveyor, Municipal Buildings.

Croydon.—Extensions (£92,000) at Heath Clark School; Riches & Blythin, architects, 97, Park Lane.

Darlington.—Primary school at Newton Aycliffe; county architect, Durham.

Durham.—Junior school at Whitburn (£54,000); M. D. Lilley and Son, Murton, Co. Durham.

Eccles.—Four-storey flats and maisonnettes (72), Barton Lane; F. Bradley, architect to T.C., Penny Bank Chambers, 4, Wood Street, Bolton.

Falmouth. — Conversion of Greenbank Laundry to motor engineering works; T. H. Nicholls, Ltd., Commercial Road, Penryn.

Gainsborough.—Processing factory, West Stockwith; Farmers Co., Ltd., Chemical Works, Barton-on-Humber.

Gateshead.—New stores, High Street, for F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1; own architects.

Gosforth.—Houses (52), Regent Farm estate; M. J. Liddell & Sons, builders, Great North Road, Newcastle-on-Tyne.

Guildford.—Retail store and offices, 65-66, High Street and 40, North Street; F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1.

Works extensions; Aldershot & District Traction Co., Ltd., Woodbridge Road.

Harrogate.—Exhibition hall, Rose Gardens; borough engineer.

Hexham.—Flats (40); W. A. Hancocks, U.D.C. surveyor.

Ilford.—Welfare hostel at Marks Gate (£50,000); H. Conolly, county architect, County Hall, Chelmsford.

Kingston-on-Thames. — Extensions to Kingston Hospital (£545,000); South West Metropolitan Regional Hospital Board, 11, Portland Place, London, W.1.

Leigh.—Police headquarters, Chapel Street (£192,583); G. Noel Hill, Lancs county architect, Fishergate Hill, Preston.

Liverpool.—Five eleven-storey blocks of flats; city architect.

London.—Factory and warehouse between City Road and Finsbury Square, Finsbury; London Investment & Mortgage Co., Ltd., 18, Upper Brook Street, W.1.

Whitefield Memorial Church, Tottenham Court Road, St. Pancras; Thomas Lowe & Sons, Ltd., builders, Broadway Chambers, W.6.

Flats (32), Coleraine Road, and houses (6), in Hardy Road, Greenwich; Harold Whetstone, town clerk, Greenwich High Road, Greenwich, S.E.10.

County secondary school, Brooke House site, Hackney (£345,364); Architects' Department, County Hall, Westminster Bridge, S.E.1.

Flats (20), Beulah Hill; Progressive Properties, Ltd., 189, Stanstead Road, S.E.23.

Mold.—Primary school, Bodelwyddan; W. Griffiths, architect, Llwynegrin, Mold.

Newcastle-on-Tyne. — Bottling factory, Blandford Street, for J. Storey & Sons; H. Gatoff, architect, 51, Grainger Street.

Houses (26), Benfield Road; J. T. Bell & Son, Market Street.

North Riding. — Additions to Malton Grammar School (£58,000); William Birch & Son, builders, York.

Northumberland.—Fire station at Allendale and old people's home at Blyth (£35,000); county architect, County Hall, Newcastle-on-Tyne.

Portishead.—Flats (24), Mendip Road; U.D.C. surveyor.

Ramsbottom.—Houses (35), Pin Meadow estate; F. Bellis, clerk to U.D.C., Council Offices.

Reading.—Development of the Royal Berks Hospital (£200,000); chief administrative officer, Reading and District Hospital Management Committee, Reading.

Seaton Sluice.—County school (£30,000); county architect, County Hall, Newcastle.

South Bank.—R.C. primary school; T. A. Crawford, 80, Borough Road, Middlesbrough.

Southend-on-Sea.—Municipal offices, college, police buildings and courts on site in Victoria Avenue; borough architect, 30, Alexandra Street.

Stevenston (Ayrshire). — Houses (50), Ardeer Mains; Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh.

Stockport.—Secondary school, Brinnington; J. Rank, borough architect.

Taunton.—Municipal college in Wellington Road (£500,000); R. O. Harris, county architect, Park Street.

Wallsend.—Adaptations and extensions to Remploy factory; Castles (Whitley Bay), 135, Tynemouth Road, Whitley Bay.

Walthamstow. — Joseph Barrett Girls' School (£142,824); H. Conolly, county architect, County Hall, Chelmsford.

Washington.—Houses (96); J. T. Robson, Springwell, Washington, Durham.

West Riding.—Occupation centre for mentally handicapped at Adwick-le-Street (£24,600); first instalments of school at South Common, Thorne (£20,000) and Rossington (£30,000) and new police station at Armthorpe (£15,487); county architect, Wakefield.

Wickford.—County secondary school (£150,000); J. M. Sheppard & Partners, architects, 38, Bedford Place, London, W.C.1.

Worcester.—Dwellings (24), Little Park Street; city surveyor.